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INDEX.

WHO WILLS WINS

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BOTANY.

FUNGI—THEIR NATURE AND HABITS.

REV. L. J. TEMPLIN.

The most casual observation of the objects that surround us reveals the fact that they consist of innumerable and greatly varied forms of organic beings. A little scrutiny shows that these all belong to one or the other of two great kingdoms—the Animal and the Vegetable. These, in their higher forms, are distinguished by such marked characteristics that they cannot be mistaken; but in their lower forms they approach each other so closely that the unprofessional observer is often at fault, and even scientists and specialists sometimes engage in grave controversies as to which kingdom an individual, or species, should be assigned. But careful and persistent investigation always succeeds in clearing up all mysteries and removing all doubts as to the place any organic being should occupy in the established system of classification. Confining our attention to vegetable organisms we find two grand series, distinguished, especially, by different modes of fructification and reproduction. These series are the phanerogamous, or flowering plants, and the cryptogamous—flowerless, or spore-bearing plants.

As between the animal and vegetable kingdoms we find the line of demarkation but dimly drawn, so we find these two series of plants so nearly approaching in some of their forms that a knowledge of their natural history is essential to enable one to readily assign them to the series to which they belong. Some

ferns and equisetæ are readily mistaken for flowering plants, while, on the other hand, some Belanophoria closely simulate some of the fungi. But even a limited knowledge of botany will enable the student to avoid such mistakes. Cryptogams are arranged in a number of different groups, of only one of which—fungi—we wish to take notice in this paper. This group, Cryptogams, are essentially different from phanerogams, or flowering plants, not only in their different modes of fructification, but also in the very principles of their organic life. Phanerogams grow by the building up of their organic structure directly from the inorganic elements under the action of the life principle, which here operates as a constructive force. But fungi grow by the appropriation and assimilation of matter that has previously been organized by some of the higher organic forms, except, perhaps, in a few isolated cases of meteoric fungi, that derive all their nutriment from the atmosphere. Common flowering plants absorb carbonic acid from the air by their leaves and green twigs, and by some vegetable chemistry the constituents of this gas are separated and the carbon is appropriated to building up the organic structure of the plant, while the oxygen is exhaled again to the atmosphere.

This process takes place only under the influence of sunlight, and by this means chlorophyl—leaf green—which is the chief agent in building up vegetable tissues, is organized. But in the growth of fungi the very reverse of this process takes place. The growing fungus derives its nutriment from matter already organized, consequently it inhales oxygen and exhales carbonic acid, just as green plants do in the dark; so no true chlorophyl is formed by this class of plants. To all fungi belong both a vegetative and a reproductive system; but there is a great difference in the comparative development of these respective parts. In some, the vegetative, and in others the reproductive organs predominate; but in some forms the reproductive system appears to be entirely wanting. In such cases it is probable that the sporeless forms are but one stage in the development of some fungus that in some other stage and under some different form will become spore-bearing.

It is a fact that is now fully established and generally known that many fungi assume such different forms and exhibit such different phenomena at different periods in their history as to be recognized as different plants, and in many cases to receive different names and be classed in different genera, orders and even families. There are anomalous cases of fructification in which there is a succession of spores produced one from another, each generation growing smaller in size, sometimes to the fourth or fifth generation, the last one entering into the proper nidus and reproducing the original form. This continued reduction in size seems to be for the purpose of reducing the spores to such dimensions as will enable them to enter the stomata of leaves, or other suitable nidus, where conditions are suitable for germination and growth. An illustrative example of this mode of fructification is found in the entophytes of the order Cæomacei, which produce spores either single or in chains at the end of fertile threads, which

grow from a delicate mycelium. When these germinate they produce others, and so on to the fifth generation in some cases.

The Bean rust—Puccinia Fabæ—has, besides male organs, four different kinds of reproductive organs, only one of which reproduces the original form, while all the others have undoubted alternation of generation. First, the puccinia appears from the spores of which the Æcidium is produced and this is followed in the regular course of generation by Uredo, the spores of which enter the leaves of the bean and are developed into the Puccinia, thus completing the cycle of transformations.

It has been shown by Professor Henslow that Uredo linearis is only a secondary form of Puccinia graminis, thus proving that rust is but an earlier form of mildew. It is also a question whether Uredo segetum and Uredo mayidis, the smut of wheat and corn, are not only incomplete forms of other fungi. The natural history of Puccinia graminis is a very interesting one. For a long time farmers had believed that there was some mysterious relation between the Barberry rust, Æcidium herberidis, and the Puccinia graminis, or wheat rust. This was sneered at by those claiming superior wisdom, as a superstition similar to the once popular notion that the moon exerted a controlling influence over terrestrial vegetation. But late investigations by men of eminence as naturalists, and of superior ability as investigators, have proved this theory to be correct. It has been observed that cereals growing in the vicinity of barberry bushes affected with the Æcidium, became affected with rust as soon as the Æcidium had completed its fructification and shed its spores. That the bushes were the origin of the Puccinia in the wheat was rendered probable by the fact that the prevalence of the disease in the grain is seen to be in exact proportion to the contiguity of this to the diseased bushes—the disease being largely developed in the grain growing near the bushes but diminishing on receding from them, till at a considerable distance it disappears altogether. But we are not left to inference in this matter even from such positive premises, for M. DeBarry proved by direct experiment that the Puccinia could be transplanted to the leaves of the Barberry, where it produced the Æcidium, the spores of which when transferred to some member of the family Gramineæ, again produces the Puccinia. That this is a very usual mode of transformation in these two forms of fungi, is established beyond question; but that this is the only method of procedure, as recently asserted by an Indiana professor is evidently not correct, for it has been proven that the spores of the Puccinia may germinate directly on plants of the grass family.

On any other hypothesis it would be impossible to account for the sudden appearance of the wheat rust over wide regions of country, destroying the growing wheat by thousands of acres, as has been observed by the writer, where there was probably not a Barberry bush, on an average, to each township. Some other means must have been employed for the propagation and dissemination of these multitudinous reproductive germs to cause such wide-spread devastation of the growing grain as has, at times, been witnessed in some parts of the country.

Another instance of polymorphism in fungi is found in a species of Isaria, that is parasitic on the Bramble moth—Bombix Rubi—which has several distinct periods and modes of fructification. This fungus in passing from one stage of its growth to another, not only changes from one species and genus to another, but it actually leaps over the chasm that separates one family from another—starting as a member of Hyphomycetes and ending as a member of the Ascomycetes family. Numerous other cases are now known and many others are suspected in which fungi that have been named and classed as entirely distinct plants are but different forms of the same species. So far as we yet know these different forms are but steps in regular cycles that invariably return to the original starting point whence again to start on their regular round of transformations.

Our present knowledge does not warrant the conclusion that any of these changes are the progressive steps from lower to higher forms of vegetable organisms. The classification of fungi is based on the mode of fructification. According to this all fungi are embraced in two grand divisions or sections, accordingly as the reproductive germs are produced in cysts or capsules, or without any such enclosing organs. In this last the reproductive germs, called spores, are produced on spicules. This section has been called Sporifera from these facts. The other division is termed Sporidifera, in which the fruiting germs are produced in cells or cysts, and are termed Sporidia. To the first of these sections belong four families, two of which are furnished with a hymenium or spore-bearing surface, while the other two are destitute of this. Of the hymeniferous families one—the Hymenomycetes—has its hymenium on an exposed surface. Of this family the common mushroom—Agaricus—with its expanded pileus and radiating gills, is a familiar example. In the second family—Gasteromycetes—though a hymenium is present, it generally remains inclosed in a peridium, or outer investing membrane, till the spores are nearly or quite mature, when, by the rupture of the peridium, the spores are liberated and discharged into the air as fine dust. The common Puff-ball (Lycoperdon,) of the meadow is a well-known example of this mode of fructification. Of the two families, belonging to sporifera, that are destitute of a hymenium, the first to be noticed is the Coniomycetes, which is noted for the abundant development, in its advanced stages, of dusty spores. So great is the predominance of the reproductive system of fungi belonging to this family tl.at at maturity nearly the whole substance of the plant seems to be converted into these spores. In the Hyphomycetes, the second family of this division, it is the spore-bearing threads or filaments that are the most noticeable for their abundance.

To this family belong that numerous class of low forms of fungi known as moulds. To these two families belong some of the most injurious species with which we are acquainted. In the first one we find that series of parasitic fungi that prove so deleterious to living plants, the Puccinia, Uredo and Æcidium. To these belong the various rusts and smuts of our grain fields.

To the second of these families belong the Mucedines, a single genus of which, the Peronospora, has proved the most destructive to living plants of any

of the parasitic fungi of any family. Here also we find the grape-vine Oidiums that have caused such havoc in the vineyards of both Europe and America. The very common moulds, Penicillium and Aspergillus, are also members of this family.

Of the Sporidifera section of fungi there are two families, the Physomycetes and Ascomycetes. In the first of these the reproductive cells termed sporidia are produced in bladder-like cells scattered on free or slightly felted fertile threads that proceed from the mycelium. The most noted order of this family is that of the Mucors in which asci with spore cells are produced in vascular sacs growing at the extremity of slender threads that spring from the mycelium or spawn. One species, the Ascophora elegans, is remarkable for having two kinds of fruit and for growing on bread while yet hot from the oven. To the Ascomycetes belong several orders of importance, among which may be mentioned the Perisporiacei, which are very destructive parasitic fungi. The mildews that infest and prove so destructive to the hop, rose, and peas, are found in this order. These form a coating of felt on the surface of the leaves that give them a white color. The Tuberacei are subterranean species, of which the Truffle is the most important. This is a highly prized article of food in many parts of Europe, and, I believe, in some of the southern parts of the United States. The Morchella furnishes a number of species that are highly esteemed as articles of diet. The number of different kinds of fungi is somewhat remarkable; more than two thousand of the more conspicuous ones have been figured. The order Agaracini contains not less than one thousand different forms, and some others are nearly, if not quite, as numerous in their genera and species.

If we direct our inquiries to the habitats of fungi we are confronted by the fact that from the frozen Steppes of the north to the burning plains of the torrid zone there is no climate, continent nor island where they are not found—on the open plains; in the deep, dark forests; on the bleak, barren mountains, and in the dark caverns; growing in the earth, on the rocks, attached to trees, logs, stumps, sticks, plants, leaves, offal, and in liquids; sending their mycelia into the stomata of leaves and the pores of timber; flourishing on all kinds of dead and decaying organic matter; and preying on all forms of living organisms, animal and vegetable; removing that which is already dead, and bringing disease and death to the living. Abounding in all latitudes, penetrating every orifice and crevice, thriving in all conditions, multiplying with a rapidity that is inconceivable, appearing at times in numbers that overwhelm the imagination, filling the air with their spores and sporidia, which by their levity are liable to be carried by the wind and sown upon all objects, where they patiently wait for the coming of conditions favorable for their germination and growth. Affecting the interests of all living beings, they command the attention and invite the study and investigation of all thoughtful students of nature. It therefore becomes a subject of interest to inquire in what manner and to what extent fungi affect other organic beings. One of the most important offices performed by this low class of organisms is to remove dead and decaying organic matter. Much of this mat-

ter, if left to decay in the air, would pollute the atmosphere with its poisonous exhalations. No sooner has life become extinct in any organic forms than they are seized upon as the nidus for innumerable forms of parasitic fungi, the spores of which have been so profusely sown upon every object, that penetrate their tissues and appropriate their substance to the building up of their own structures. In thus removing useless and offensive matter that would prove deleterious to health, these fungi prove beneficial. But some of them attack and destroy the texture of sound timbers to the great damage of buildings and structures. As, for instance, that one known as dry rot—Merulius lachrymans—that attacks the sound timbers of buildings, etc., sending its mycelium into the pores of the wood and reducing the inner portions to a rotten, worthless condition. Another similar one is Polyporus hybridus, which attacks oak-built vessels and causes much damage to them. But it is those parasitic fungi that prey upon living plants and animals that cause the most serious losses and are to be the most dreaded.

We need allude to but few of these parasites on living beings to illustrate the destructive power of these cryptogamic forms. The potato fungus—Peronospora infestans—has attracted more attention and caused greater ravages, probably, than any other parasitic plant in modern times. This has caused losses to the extent of hundreds, if not thousands, of millions of dollars since it first began its extensive ravages some forty years ago. The ravages of Puccinia on the cereals and of Uredo on maize, with their extensive damages, are too well and generally known to need extended elucidation.

The hop mildew has been the cause of extensive losses to that crop in those regions where it is extensively cultivated. The rose, verbena, hollyhock, gooseberry, bean, and indeed nearly every species of plant, are subject to the attacks of one or more species of cryptogamic parasites.

The rot in the apple, the blight in the pear, and the yellows in the peach are traceable to a similar cause. Were it not for the power of these low organisms, in connection with predatory insects, to hold in check the luxuriance of vegetable life, it is probable there would be such an exuberance of these forms as to literally overrun the earth. But if in this light, fungi are to be regarded as beneficial, it must be admitted that in many instances, as noted above, the matter is largely overdone—we have entirely too much of a good thing. But the attacks of fungi on living organisms are not confined to the vegetable world. Animals also are subject to these attacks. There no longer remains any doubt that many diseases are caused by the presence of fungi in the animal system. The White grub, the larva of Lachnosterna, is attacked by a species of fungus, probably a Sphærea, that grows in the form of sprouts from the sides of the mouth of the insect.

The disease among bees, known as "foul brood," is caused by a fungus that spreads over the surface of the comb and sends its mycelium into the young larvæ, soon reducing them to a putrid, stinking mass. The silk-worm disease that has proved such a scourge to the silk interest in France, is caused by the fungus Botrytis bassiana, that seems to defy all efforts for its extermination. The

common house-fly, Musca domestica, is subject to a species of fungus now called Sporendonema muscæ, that kills its victim and afterwards appears as a mouldy halo around it. The Bramble moth, Bambyx rubi, is attacked and killed by a species of Isaria. Different genera of this sub-order are found on dead larvæ of moths, dead spiders, etc., but whether they are the cause or consequence of death in these cases is doubtful. Some members of the wasp family—Vespa—are subject to the attacks of the fungus, Torrubia sphenococephala, which may be often seen protruding from the insect while still living. Numerous insects of widely different orders are attacked by a great number of species of spheriaceous fungi.

Certain species of fungi often prove quite destructive to fish, especially to the young fry. The ova of toads and frogs have been found penetrated by this same aquatic fungus. The mycelia of fungoid plants have been found in the tissues of birds, and even the ovum is not exempt, as Signor Pancery, of Naples, discovered no less than seven species in the albumen of hen's eggs. May we not have here a hint as to the manner in which hereditary diseases are transmitted from parent to offspring? Man is subject also to the deleterious influences of fungoid organisms. Mr. Hogg has discovered as many as fourteen different forms of fungi in as many different cutaneous diseases. Scald-head, ring-worms, tetter, etc., are produced in this way.

Many, if not most, of the diseases to which man is liable, are the effects of living germs of a fungoid nature. Ague, typhoid, typhus, scarlet and yellow fevers, small-pox, cholera, measles, diphtheria and other diseases are believed to originate in this cause, and in regard to many there is no longer any doubt. Consumption has recently been traced to the existence of bacillus in the pulmonary organs.

A common disease in India, called Madura foot, is caused a by fungus, the mycelium of which penetrates the tissues of the foot, changing the flesh and bones to a diseased mass full of cavities and channels. We are therefore led to the conclusion that a knowledge of the nature, history and habits of fungoid vegetation is intimately related to the welfare of the human family, and should be more generally studied and understood than has hitherto been the case.

There are some peculiarities belonging to some of the members of this class of vegetation that may be of interest to notice before leaving the subject. While many of them have the spore or sporidia-bearing surface exposed to the light, others seem to avoid this position, constantly keeping the fruiting surface turned away from the light. An illustrative example of this is found in Polyporei, which are so averse to direct light on the hymenium that, if the plant be reversed so as to expose that side, the fructiferous surface is gradually obliterated and a new one is formed on the under surface. In many fungi, if a cut surface be exposed to the air it is soon changed in color, generally to a blue tint. The Boleti may be cited as an illustration of this property. When a slice of B. luridis or of B. cyanescense is exposed it soon acquires this color, caused, according to Dr. Phipson, by the action of the ozone of the atmosphere on the aeetate of aniline

that is found to be a constituent of these fungi. A remarkable phenomenon attending some fungi is the emission of a considerable degree of heat. The Boletus æneus is declared by Dutrochet to evolve more heat than any other vegetable known except the Aurum. But a still more remarkable phenomenon manifested by fungi is the emission of light. Numerous fungi in different parts of the world possess the property of luminosity. Agaricus olearius, growing on the olive trees in the south of France possesses this quality in a high degree. Also A. gardneri, a fungous parasitic on the Pintado palm of Brazil, is noted for its luminosity. Luminous fungi are quite common in this country. We have often seen large surfaces of decaying timber giving out a very brilliant phosphorescent light from the numerous mycelia that had penetrated the pores of the wood. This luminous wood, under the name of "fox-fire," is often exhibited by boys as a curiosity.

The cause of this luminous property of fungi has been the subject of much controversy, but as in the experiments of M. Tuslane the luminosity was extinguished in a non-respirable gas, and also in vacuo, it is quite probable that it is the result of a slow combination of the oxygen of the air with some property peculiar to the plant.

Another notable phenomenon observed in some, especially in the spores, is the motile power they possess. Some spores are furnished with cilia which, by their contraction and expansion, enable the germ to move about like a thing of life. Some of these, especially the Myxogastres, so nearly simulate the animal amœbæ in their motions that many naturalists have insisted on placing them in the animal kingdom; but this view is now generally abandoned and they are accorded their proper place among vegetable organisms. Fungi differ exceedingly in the odors they emit, some of them being very agreeable while others send out a most intolerable stench.

The writer well remembers, when a boy, of searching the woods for a certain species, probably a Polyporus, that grew on the decaying timber of the sugar maple, acer saccharinum, and exhaled a very agreeable, musky flavor when not inhaled too strong, for in that case it was too pungent to be pleasant. Of the fruiting germs, their mode of production, fertilization, distribution, germination and growth we might speak at length; and here we might find one of the most interesting fields for investigation in all the vegetable kingdom, but space forbids our entering into this interesting part of the subject, and we must be content to have taken this cursory glance at the part of the field noticed and with a faint hope that at some future time we may be able to learn more of these objects, among the most minute and wonderful of all the works of Nature.

THE FLORA OF THE DAKOTA GROUP.

CHARLES H. STERNBERG.

If the reader will go with me in imagination, we will visit the shores of the great cretaceous ocean that once beat against the carboniferous hills. We have to roll back the centuries, several thousands of them, when Time was not near so grey as now. We walk along the boundless sea whose western boundaries no scientist has ever traveled. We find the eastern coast-line of this great ocean enters Kansas near the mouth of Cow Creek and taking a northeasterly direction, passes through Dickinson, Cloud, and Washington counties; and in the same direction through Nebraska, touches Iowa, through Minnesota into British America, and so on to Greenland. Great sand flats are projected above the waves during low water, while here and there, often miles apart, islands lift themselves above the waves. They are covered with luxuriant forests.

We will visit these islands and study their magnificent flora. We find they closely resemble the trees of our own southern shores. Here the grand Red-wood or *Sequoia* reaches 300 feet into the air; beside it, the magnificent Catalpa, *Protophyllum*. Here a grove of elegant Poplars, *Popular Elegans*, delights the eye; their beautiful leaves waving backward and forward at the slightest breeze. Near by are clumps of Sassafras, *Sassafras Mirabile*, with leaves that measure a foot across. I am writing as though all these species grew near together, which is not the case, as each island has its own peculiar flora.

Yonder a stately Menispermites lifts its magnificent head into the air, one of the finest known trees that is now cultivated in our conservatories, on account of its beautiful foliage; then comes that other grand tree, with numerous species, *Liriodendron*, or Tulip tree, with its peculiar anchor-shaped leaves. We find also another wonderful tree, with leaves a foot in length. They are thick and leathery, with powerful ribs, the mid-rib being perfoliate, i. e., passing through the leaf near its base; the margin of the leaf is wavy. This species has no representative living. The genus and species being both new to science. I discovered it in but two localities, one near Fort Harker, the other a few miles from Minneapolis, 100 miles apart; it is called *Aspidrophyllum Trilobatum*.

Another beautiful tree that is much sought for now by ornamental gardeners, is the *Aralia*, or Sweet Gum. Its graceful leaves have from three to five lobes, that are cut down nearly to the mid-rib. One magnificent species, *Aralia Saporteana*, has serrated lobes.

The Sassafras is the most common of cretaceous plants, represented by numerous species. One, *Sassafras Mudgii*, resembles the Sassafras of Ohio.

On the ground under the trees grow the pretty fern *Gleichenia Turriana*.

The Cinnamon and Fig *Ficus*, are represented by numerous species.

I discovered a number of figs that were new to science. The Beech, *Betula*, is also found.

These species show that the climate resembles that of Virginia. Conifera are represented by *Glyptostrobus Gracillissimus*, resembling the *Norway Pine*. I found their cones, but they are rare.

Liquidambra Integrifolia with its lobes cut down nearly to the middle, is quite a common cretaceous plant; Willows, *Salix;* Black Walnut, *Juglans;* Oak, *Quercus;* Maple, *Acer;* Bass-wood, *Platanus;* Magnolia, *Rhamnus;* Box-elder, *Negundoides* and Plum, *Prunus*, are common in the Dakota flora. Another tree with fern-like leaves, *Todea Saporteana*, is found. One species with parallel veins, *Phragmites*, is the only species I discovered in the cretaceous with veins arranged in this way, proving that the climate did not resemble that of the tropics, where the Palm with parallel veins and others like it, are in the majority.

One very peculiar species, the *Eremophyllum Fimbriatum*, has leaves that are dental from their lower margin, with equal short teeth, appendaged with obtuse auricles, and separated by half-round sinuses.

Searching along the mud flats, we find numerous leaves have fallen in and are partly covered. Lifting one up carefully, we find beneath, an exact cast of the leaf, and thus have the impressions, we find now in the sandstone of the Dakota, been made. Often the soft sand was by pressure packed into solid rock, the impressions were indelibly stamped.

The noted Palæo-Botanist, Prof. Leo Lesquereux, has been able through these impressions, to study the whole Dakota flora and identify the species as readily as if the trees were before him. His interesting work, "The Cretaceous Flora," has been published by the Government in Vol. VI, of the Geological Survey under Prof. F. V Hayden. It is a magnificent work, beautifully illustrated with thirty lithographic plates. In a later work called "The Review of the Cretaceous Flora," he has described and figured twenty-five new species discovered by myself, and later, during my expedition for Prof. Agassiz, I discovered twenty new species, and 800 specimens beautifully preserved, that have been described by Prof. Lesquereux. About 200 species of forest trees have been discovered in the sandstone of the Dakota Group, and described by the Professor and Doctor Newberry.

This Dakota Flora is a wonderful disproof of the theory of Natural Selection. Here we find at the base of the cretaceous, millions upon millions of years old, a flora as perfect as any of the present day. There has been no improvement during all these ages. Some of these species are called new, more on account of the position in which they are found, than from any dissimilarity between them and those of recent species.

What has Nature been doing in the vegetable kingdom during these countless centuries? Is the line of development confined only to animals? And more wonderful still, these perfect plants appear for the first time in the earth's history. Like the hero of old that came into the world full-grown and ready armed, so the grand flora of the Dakota appeared with no intermediate species between it and the coal plants of the carboniferous. Let the scientists of the Darwinian

school explain this fact and make it conform to the theory of Evolution if they can.

Another proof of the richness of the vegetation during the Dakota epoch, is fonnd in the fact that nearly all the sandstone laid down during that time, is strongly impregnated with iron, showing that it had been first accumulated by plants. There are also beds, of considerable extent, of impure coal, that is mined and used by people for fuel in western Kansas. In addition to the sandstone, are beds of shales and various colored clays. Some of them contaian iron pyrites, crystals of gypsum and alum. I once found a spring flowing from a bed of shale that contained so much alum that the taste was quite perceptible. Scattered through the formation are enormous sandy concretions, often twenty feet in diameter, circular in shape, flattened above and below; two or three are often joined together. They sometimes rest on softer rock, which has been washed into pillar-like supports, and they resemble large mushrooms. The rocks of the formation are estimated to be about 200 feet thick. I have traced the same formation in Texas, near Weatherford, where they top the limestone of the Permian. In one place I saw an escarpment of red sandstone thirty feet thick; it contained fragments of *sassafras cretaceum.*

In searching for fossil-plants, there is nothing to indicate their presence. The sandstone is all the same, and one may look at every exposure with no results for miles, and perhaps suddenly stumble upon a rich locality in the same kind of rock. The sandstone makes fine building material.

In this formation, I have found a locality of fine white sand which I use in making a scouring soap. The deposit is eighty feet long, twenty feet thick, and extending into the bluffs. The surface features of this group are a broken, hilly country, often so rough, in fact, as to be unfit for farming, though it makes a good range. Fine springs of pure water gush out of the hill-sides that do not freeze in the coldest weather. These springs are sometimes utilized in milk-houses, and the water allowed to flow around the sides of the milk-pans, keeping them at an even temperature. In Kansas the formation is about sixty miles wide, except along the Arkansas, where it extends to the western boundary of the State.

That the rocks are of marine origin, is proved by the presence of sea shells. They are quite abundant south-east of Brookville. No animal remains have been found, unless the theory of Prof. Cope is correct. He claims that all the wonderful remains of dinosaurs found in Colorado, belong to this formation. Some of these enormous reptiles reach a height of twenty-five feet, and length of sixty feet. They are the largest known land animals and were herbivorous in habit, feeding on the branches of trees. Prof. Marsh places the deposit in the Jurassic age. Whether fossil plants have been found associated with the bones or not I am unable to say, neither can I give the data from which Prof. Cope forms his conclusions.

A vast territory in the Dakota group remains still unexplored and promises a rich harvest of things, new and old, to the ones who will be enabled to give the whole formation a careful examination. I trust it will be done at an early date.

I give below a list of the localities where fossil leaves are found, which will be found of value to any one who may wish to make collections. From what I have written, you will see how rare these localities are. It will also be interesting in showing the distribution of Dakota plants.

1. Near the bridge on Thompson Creek, at Mr. Scott's place, seven miles south of Fort Harker. Characteristic species: *Sassafras mirabile, S. cretaceum, S. obtusum, Cissites harkeranii, Menispermites ovalis, Sequoia formosa, Photophyllum sternbergii, P. minus, Glyptostrobus gracillissimus, Laurophyllum reticulatum.*

2. Two miles above the bridge on Mr. Hudson's place called Rye Hollow: *Ficus sassafras cretaceum* and *obtusum.*

3. Sassafras Hollow, seven and one-half miles south of Fort Harker near mouth of Dry Creek: *Sassafras cretaceum, S. Obtusum* and *S. mirabile, Protophyllum sternbergii, P. minus, P. quadratum,* and *P. rugosum.*

4. Hay-stack Mountain near Bluff Creek, twelve miles south of Fort Harker: *Liquidambra integrifolia, Aralia concreta, Sassafras cretaceum, S. mirabile, S. obtusum, Protophyllum sternbergii, P. minus,* and *P. rugosum.*

5. Three miles south of Fort Harker, above high bluffs, on the river: *Aralia quinquepartita, A. tripartita, A. saporteana, Lamophyllum reticulatum.*

6. Five miles south-west of Fort Harker, on Skunk Creek, above John Essick's place: *Glyptostrobus gracillissimus, Pinus,* leaves and cones. *Sassafras,* several species. *Populites elegans, Liquidambra integrifolia,* Ferns, etc.

7. Six miles southwest of Fort Harker, on Ash Creek, near Mrs. Ward's place: *Liquidambra, Sassafras* and *Platanus.*

8. South of Fort Harker, on Skunk Creek, on Mr. Hoofland's place: *Aralia saporteana, A. tripartita, Daphnegenoides protofolia, Laurus nebrascensis.*

9. Skunk Creek, Section 36: *Betula beatriciana* and *Laurus nebrascensis.*

10. Elk Horn Creek, twelve miles northeast of Ellsworth's: *Liriodendron cruciformæ, Salix protofolia, Liriophyllum* and *Phragmites.*

11. Six miles northwest of Brookville, near Mr. Sherman's: *Aralia saporteana.*

12. Mulberry Creek, fifteen miles northwest of Clay Center: *Platanus heerii* and *Sassafras.*

13. Seven miles northeast of Glasco: *Phragmites, Salix, Fagus, Betula, Seltis,* etc.

14. Two and a half miles southwest of Glasco: *Liriodendron,* 3 species—*Todea, Pteris, Magnolia, Laurophyllum, Fagus, Celtis, Quercus, Glyptostrobus, Aralia, Liquidambra, Populites, Juglans, Cinnamom, Sequoia* and *Phragmites.*

15. Two miles northeast of Minneapolis: *Sassafras* and *Cissites.*

16. Four miles northeast of Minneapolis: *Aspidrophyllum trilobatum* and *Populites.*

17. Twenty miles above Salina: *Sassafras Mudgii, Cissites, Menispermites, Obtusitola.*

18. Four miles southeast of Fort Harker: *Aspidrophyllum trilobatum, Aralia, Downeri,* etc.

ENTOMOLOGY.

RECENT PROGRESS IN ECONOMIC ENTOMOLOGY.[1]

PROFESSOR C. V. RILEY.

The paper set forth the part which insects play in the economy of nature and particularly their influence on American Agriculture. The earlier writers on applied entomology in the United States, as Peck, Harris, Fitch, Walsh, Le-Baron, and Glover, did some excellent work in their studies of the habits and life-histories of injurious species, but the most important results followed when such studies were combined with field work and experiment by competent persons and upon scientific principles. A number of the remedies proposed in the agricultural press are foolish and based on misleading empiricism. Economic entomology as a science is of comparatively recent date. It implies full knowledge of the particular injurious species to be dealt with and of its enemies; of its relations to other animals and to wild and cultivated plants. In short, its whole environment must be considered, especially from the standpoint of the farmers' wants. The habits of birds, more particularly, and the bearings of meteorology and of the development of minute parasitic organisms, must be considered. Experiments with insecticides and appliances will then be intelligent, and successful in proportion as the facts of chemistry, dynamics and mechanics are utilized.

The complicated nature of the problem was illustrated by the life-history of *Phylloxera vastatrix*, Planchon, and the difficulties often encountered in acquiring the facts were illustrated by the late work on *Aletia xylina*, (Say).

The chief insecticides considered for general use and applicable above ground were tobacco, white hellebore, soap, arsenical compounds, petroleum and pyrethrum; those for use under ground, naphthaline, sulpho-carbonates of potassium and bisulphide of carbon. The most advantageous and improved methods of utilizing each were indicated. Recent experiment showed that kerosene emulsions, such as had been recommended lately in the author's official reports, were superior to bisulphide of carbon, when used under ground against the grape *Phylloxera*, and the discovery is deemed of great importance, especially to the French people, and those on the Pacific slope. Contrary to general belief, Pyrethrum powder was shown to have a peculiar and toxic effect on higher animals as well as on the lower forms of life. Its deadly influence on lower organisms led the author to strongly recommend its use as a disinfectant and to express the belief that it would yet come to be used in medicine. Dr. Hagen's recommendation of the use of yeast ferment was touched upon. It had proved of little or no practical avail

1. Abstract of a paper read before the Philosophical Society, Washington, D. C., at its meeting February 2, 1881.

and some of the publications on the subject were characterized as unscientific. The use of malodorous substances as repellents which had been much relied on in the early days of economic entomology and strongly recommended by the two Downings, had lately been agitated as a new principle for the prevention of insect attack by Professor John Lintner. The principle could be applied in exceptional cases to advantage, but experiment gave but little hope of its utility against most of our worst field insects. Professor S. A. Forbes is engaged in interesting researches having for object the utilization of micro-organisms, but with more promise for pure than applied science.

Of recent progress in mechanical appliances the paper dealt with those lately perfected under the author's direction of Dr. W. S. Barnard, one of his assistants. This part of the subject was illustrated by models and by plates from the forthcoming Fourth Report of the U. S. Entomological Commission.

The paper concluded with the following plea for applied science: "Matters of fact do not tend to provoke thought and discussion, and I must confess to some misgivings in bringing these practical considerations before a body which reflects some of the highest and purest science and philosophy of the nation. From the days of Archimedes down to the present day there has existed a disposition to decry applied science and to sneer at the practical man. Yet I often think that science—no matter in what fine sounding name we clothe her, or how high above the average understanding we stilt her—is, after all, but common sense employed in discovering the hidden secrets of the universe and in turning them to man's wants, whether sensual or intellectual. Between the unbalanced vaporings of the pseudo-scientific theorizer and the uninformed empiric who stumbles upon a discovery, there is the firm middle-ground of logical induction and deduction, and true science can neither be exalted by its inapplicability nor degraded by its subserviency to man's material welfare. The best results follow when the pure and the applied go hand in hand; when theory and practice are wedded. Erstwhile the naturalist was honored in proportion as he dealt with the dry bones of his science. Pedantry and taxonomy overshadowed biologic research. To-day—largely through Charles Darwin's influence—we recognize the necessity of drawing our inspiration more directly from the vital manifestations of Nature in our attempt to solve some of the many far-reaching problems which modern science presents. The fields of biology, morphology, physiology and psychology are more inviting than formerly. Nor is the lustre that glorifies the names of Stevenson, Watts, Faraday, Franklin, Morse, Henry, Siemens, and a host of yet living investigators dimmed because they made science useful. Gœthe makes Wagner say:

"Ach wenn man so in sein Museum gebannt ist
Und sieht die Weltkaum einen Feiertag,
Kaum durch ein Fernglas, eur von Weiten,
Wie soll man sie durch 'Uberredung leiten?'"

If to-day, right here in Washington, there is great activity in the field of

original research; if the nation is encouraging it in a manner we may well be proud of, the fact is due in no small degree to the efforts of those, many of them members of this Society, who have made practical ends a means, rather than to those who would make science more exclusive and who are indifferent to practical ends or popular sympathy. Such at least is my apology for the nature of this paper.

PHYSICS.

ON THE PROGRESS OF ELECTRIC LIGHTING.[1]

WILLIAM HENRY PREECE, F.R.S.

I propose briefly to indicate some of the progress made, both in a scientific and practical sense, and to show that electric lighting is a real, true success.

* * * * * * *

As regards the scientific progress little has to be said. We had learned nearly all we wanted to know before electric lighting had entered its practical stage. In reality, the very fact that it had entered its practical age was a proof that it had passed through its infancy of scientific tuition. The conditions that determined its production, the laws that regulated its behavior, the means that were available for its control, had all been thoroughly investigated and laid down before practice stepped in to show us what could be done.

Electricity can be produced, currents can be distributed, light can be generated, but we have yet to learn how all this can be supplied economically, profitably, and with safety to person and to property. Practice alone can determine these points, and it is well to make a rapid survey of the extent to which practice has up to now enabled us to solve these points. The future of electric lighting is now in the hands of practical men.

Electric lighting has called for motors of a class not hitherto in demand, and steam, gas, and water engineers have rushed to the front to meet the demand. The production of electric currents means the expenditure of power; and when the extent of the installation is known, it is a simple calculation to specify how much horse-power is needed. Some employ a fall of water to urge a turbine, others employ steam, many use gas to obtain the power requisite to convert the energy of mechanical motion into that of electric currents. Gas-engines are being very largely used, and since the expenditure of a given amount of gas as power, will produce more light through the agency of electricity than by direct combustion in air, it is clear that we have here an evidence of the true function of gas. The perfect gas-engine has not yet been produced. Those in use are

1. Paper read before the Society of Arts, London, March 5, 1884.

too noisy, too irregular, and sometimes uncertain, but the advances made are very marked and very encouraging. The hall in which we are is, as you see, brilliantly illuminated by a gas-engine. Those little lamps, though electric glow lamps, are in fact lighted by gas, though the gas itself is consumed in the cellar. The light we enjoy is only a form of the energy which has been brought into this building by the Gas Light and Coke Company. In all cases of electric lighting electricity is merely the agent which transforms the pent-up energy contained in water, steam, or gas, into that of light. Hence it is that so much of the efficiency of electric lighting apparatus depends upon the instrument called the "dynamo," by which the conversion of this energy is brought about, and here it is that so much inventive skill has been expended, and so much real progress has been made.

The tendency of recent improvements has been to improve the mechanical details, and to increase the output of the smaller machines. Thus by increasing the quantity and quality of iron, by better winding, and by re-arranging some parts of the machines, Dr. Hopkinson has succeeded in doubling the output of the Edison dynamo. Mr. Crompton, by somewhat similar means, and by using the purest iron obtainable, has succeded in making his Bürgin dynamo light up 210 lamps, instead of 90. Sir William Thomson and Mr. Ferranti have turned out a little machine which succeeds in lighting up 1,000 lamps by a mass of metal, which two years ago would not have illuminated 100 similar lamps.

Thus we have a process which is still actively going on, by which the economical output of a given weight of material is vastly increased.

One of the most interesting objects at the Fisheries Exhibition last year was the Hochhausen dynamo, which is one of the most remarkable yet brought into the market. Those who visit the forthcoming Health Exhibition will have an opportunity of inspecting it. The main features of this dynamo are the extreme simplicity and mechanical accuracy of its parts, the automatic mode of governing, its great adaptability, so that it can be varied at will either to high or low tension, and the remarkably low velocity for such high electro-motive force.

The distribution of the currents through conductors is one of the problems that demands the highest skill of the engineer, not alone for the efficient working of the system, but for its economy. It is not sufficient to convert our useful energy into electric currents, we want to distribute them with the least possible waste. Conduction means waste, and this waste can be controlled only by using the purest metal, and by so regulating the electro-motive force and dimensions of the conductor as to obtain the maximum effect with the minimum means. It is an exceedingly difficult problem to solve. The metal universally used is copper, but very few people take the precaution to test its purity, Contractors go to the cheapest market, and the result is they get the nastiest material. I know of conductors that give only 70 per cent of the conductivity that they should give. This means largely increased waste, and greatly enhanced cost of working. Impure copper not only means needless waste, but waste means heat, and therefore danger.

But wasted energy may also take the form of leakage, or direct loss of current. This is cured only by good insulation. Good insulation unfortunately means expense; and here again competition has forced too much economy. I have not examined one single case of the failure of an electric light that has not been traceable either to crass ignorance, or to needless economy. Perfectly well insulated copper conductors are within the reach of all who choose to pay for them; but when proper specification, proper inspection, and proper tests are neglected, we must expect, as has too often happened, failure and expense.

A marvellous improvement has been made by Dr. John Hopkinson and by Mr. Edison, independently of each other, by which the weight of copper necessary for central station working has been diminished 60 per cent, and this is due to the use of two dynamos connected in series, and a third, or compensating conductor, placed between them. The weight of copper necessary for a conductor can also be diminished by the use of high tension currents, and this has led to various suggestions by which high tension currents shall be used for charging secondary batteries, and for exciting induction coils, but the use of high tension currents for household purposes is at present regarded as dangerous. High tension currents are, however, available for public street lighting, and are very satisfactorily employed for this purpose. There is a very senseless crusade being conducted just now in certain quarters against overhead wires. Overhead wires, if properly constructed, are most desirable, especially for electric lighting. It is the terrible abuse of this mode of construction that has caused the present onslaught upon them. Overhead wires can be made absolutely secure; they need not be a disfigurement nor an injury; they are far more readily maintained than underground wires; they facilitate the economy of electric lighting, not only by affording better conductors, but by radiating away the waste heat generated, and by requiring fewer joints and connecting points.

I do not in the least object to overhead wires through our streets for public lighting, though I strongly object to the cloud of wires that now obstruct the sky line in many of our thoroughfares. When ugly objects form an essential function of utility, it is wonderful how their unsightliness is condoned. Who complains of the ugliness of gas lamp-posts, and what is there in the necessary adjuncts of town life more ungraceful or hideous?

I do not, however, advocate overhead wires for general lighting. The conductors in that case must go underground, and with the great demand for telegraphs, telephones, and electric lighting, it is a pity that our corporations do not extend that useful system of subways, that has been partially carried out in the City of London, for easy fixing and inspection. The present mode of laying pipes in trenches is not only costly, but dangerous, and it has led to many more accidents than have been occasioned by the falling of overhead wires. Our streets are almost always open for either gas, water, telegraphs, or telephones, and the evil is increasing, and will continue to increase, with electric lighting. The cure is proper subways.

The progress made during the past two years in the form and character of lamps, whether arc or glow, has not been very marked. In arc lamps the tendency has been to simplify the working parts, and to increase their steadiness of action. The Crompton, Pilsen, and Fyfe-Main lamps leave little to be desired in this respect. At the Vienna Exhibition there was a remarkably steady lamp in the French Section, the Abdank lamp, but it has not been seen in England yet. The arc lamp has many serious defects, which circumscribe its value very considerably, but it is eminently adapted for workshops, railway goods yards, and for large spaces where high masts can be fixed.

For general domestic illumination the glow lamp, as made by Swan and Edison, is, in my opinion, the only proper one. At the Munich and Vienna Exhibitions, a remarkable lamp by Cruto, of Turin, was shown. It gave very good results, and absorbed a very small current, but it is not in the market yet. At Vienna the Bernstein lamp attracted much attention. It was a thin carbon tube made by carbonizing a hollow silk ribbon, but it had low resistance, and required much current. It gave a considerably higher candle-power than we are accustomed to. For instance, one lamp requiring 5 ampères and 30 volts, gave 60 candles; and another, with 8·5 ampères and 35 volts, gave 100 candles. Its normal efficiency of 2·5 watts per candle was very low, the efficiency of the Swan lamp being 3·5 watts per candle, and that of the Edison 4 watts per candle. Its duration is said to be very great. All glow lamps can be made to give economical results when we use large currents, but, unfortunately, their life is much curtailed by doing so. The filament is disintegrated, and the inside of the glass is, in consequence, covered with a dark deposit. Hence we are obliged to be satisfied with low efficiency to obtain reasonable durability.

The Bernstein lamp is, however, of an inconvenient power, and while it may do for street lighting, and for large spaces, it is not adapted, in its present form, for our rooms and offices. It is, therefore, a lamp that is more likely to replace arc lamps than the present glow lamps, as made by Edison and Swan. It has, however, shown us a direction in which economy can be effected, and we may reasonably hope that the workers in this field will soon find a means to improve the present efficiency of the small glow lamps, and thus reduce the cost of working them.

A good many private houses, as well as public establishments, have been recently fitted up, and their experience has developed many difficulties and dangers which have only to be found out to enable them to be overcome. There is no use ignoring the fact that the admission of electric currents into our homes means the admission of a new danger—a danger that is only to be surmounted by the dictates of experience. Careful rules and regulations have been drawn up for the guidance of those who are executing installation, but the true remedy is to employ none but skillful and experienced contractors, and to have premises properly inspected by recognized professional men. Under such guidance electric light leads can be made absolutely harmless and devoid of all danger. The same cannot he said of gas, oil, or candle, for they involve the use of matches,

and are always in a condition of potential danger. 2,041 persons in England alone, in 1881, met with violent deaths from burns, scalds, and explosions (not in mines). In one week, not long ago, six deaths from explosions of gas were recorded in the *Times*. Hence, while electricity is certainly accompanied by its own dangers, these dangers can be neutralized, and other infinitely more serious ones can be completely expelled from our houses.

Mr. Killingworth Hedges has devoted a great deal of attention to safety catches, and he certainly has produced the most efficient that are in the market. No electric light lead should be without its safety plug or cut-out. It is a precaution of a cheap and simple character, efficient, and reliable in action. A bar or sheet of lead, or alloy, is inserted in the circuit, which is instantly fused when from any cause the current exceeds its proper amount. It is a nuisance to be left in the dark, which must happen when the safety catch is fused, for the circuit is broken; but one can submit to this when the result is safety gained, or some source of danger eliminated. The remedy is a little barbarous, but it is efficient. A less crude contrivance was shown in Vienna—the invention of Mr. Anderson—but I have not seen it in practice.

It is most desirable that we should have, in every electric light installation, instruments to measure the current flowing and the electric pressure present. Ammeters, or current measures, and voltmeters, or pressure indicators, are very numerous.

Another important economical feature is the proper distribution of light, and Trotter's dioptric system is very ingenious and useful.

I scarcely think that the true solution of isolated house lighting will be secured until we can obtain reliable, effective, and economical secondary batteries. Plante's original accumulator, as improved by Faure, Sellon, and Volckmar, has not yet reached that stage of perfection that one would wish to see, but the progress towards this desideratum is steady and promising. Planté has himself made a decided improvement by preparing his lead plates in nitric acid, and the experiments that I have made with his cells, as supplied by Elwell and Parker, of Wolverhampton, are so encouraging that I am about to use a set of them in my own house. A secondary battery has this advantage, that your electricity is stored up to be used when you want it, by day or night, without the constant use of machinery. In ordinary houses, such as mine, there ought not to be required more than one day a week for charging—a day set apart for the purpose like washing-day—when sufficient electricity should be stored up for a week's work. I scarcely hope to do this yet, but it is well within the bounds of possibility.

I have indicated to you the direction in which progress has been made. The output of the apparatus has been greatly increased, and, therefore, the capital required for installation reduced, the expenditure on conductors has been considerably diminished, the efficiency of the lamps—especially in their durability—has been improved, and all these steps in advance have the tendency to economize the production of the electric light. But the progress is being continued, and

there is vast room for this improvement. Nothing approaching finality has yet been reached.

I see no reason whatever why our public streets should not be as efficiently lighted by electricity as they are now by gas, and for the same price. But the public are not satisfied with the same illumination; they will have more light. They are spoiled by the dazzling splendor of the arc lamp, and they treat with contempt the less showy glow lamp. Nevertheless, the best lighted street in the City of London is the Holborn Viaduct. The Thames Embankment and Waterloo Bridge have now been lighted by fifty arc lamps for over five years by the Jablochkoff Company. Blackfriars Bridge, Bridge Street, Ludgate Hill, St. Paul's Churchyard, and Cheapside have been lighted by thirty-eight Brush arc lamps for three years. We are now engaged in a very interesting series of experiments at Wimbledon, to determine the best and most efficient way of lighting public streets, and much value in an economical sense will, it is hoped, accrue from these trials.

It is remarkable how the use of electricity is growing in favor with theatre managers. Supported by the success of the Savoy, the Criterion, and the new Prince's Theatre in London, the Prince's Theatre in Manchester, the Prince of Wales and the Royal Theatres in Birmingham, two theatres in Glasgow, and many others, are following Mr. D'Oyley Carte's spirited venture, and who can refrain from wishing that all would follow his example? Cool and pure air, absence of headache, and cheerfulness of mind are experienced at the Savoy, while the reverse is felt elsewhere where gas is used. I have recently examined the estimates for lighting up the Opera House in Vienna, and I have every reason to believe that less than 30s. per lamp per annum will brilliantly illuminate that beautiful house, and give a handsome return to those who have undertaken the contract.

There are many small central stations at work in England, but none on a large scale. At New York there are several. The Edison Company's first station lights 431 houses, and 10,300 lamps, and they are now erecting two new ones for 50,000 and 70,000 lamps respectively. We have in London one at work on the Holborn Viaduct, another at Brixton, and another for 5,700 lamps will shortly be opened at Victoria Station. There are small central stations at Godalming, Chesterfield, and Colchester. The Hammond Company have one at Brighton, which works over an area of seven miles. This company maintains 900 arc lamps and 5,500 glow lamps in different places in England. There is a central station at the Edgware Road Station of the Metropolitan Railway, whence Notting Hill Gate, Gower Street, King's Cross, and Aldgate Stations are lighted over a length of fifteen miles long. One hundred and fifty-one glow and five arc lamps are illuminated by the distributing system of Gaulard and Gibbs. Lord Salisbury, an amateur electrician of no mean type, has established quite a system of his own at Hatfield. The *Times*, ever in the van of progress, has for four years lighted up its printing and compositors' room.

Our new Law Courts are admirably lighted, and some of the judges have

said that the electric light is the only good thing in this new Palace of Justice. The House of Commons has gradually been fitted up, and the Colonial Parliament Houses in Cape Town and New South Wales are following the examples. Indeed, restaurants, hotels, and public buildings are all testifying to the fact that I am so anxious to bring before you, that electric lighting is a decided success, for they are using it. But we want to see it in our homes. An excellent little book on this point has recently been published by Mr. Hammond, which is well worth your perusal. He has given there a table so striking and convincing that I have had it copied and suspended for your information:

The following table shows the oxygen consumed, the carbonic acid produced, and the air vitiated by the combustion of certain bodies burned so as to give the light of twelve standard sperm candles, each candle burning at the rate of 120 grains per hour:

Burnt to give light of 12 candles, equal to 120 grs. per hour.	Cubic feet of oxygen consumed.	Cubic feet of air consumed.	Cubic feet of carbonic acid produced.	Cubic feet of air vitiated.	Heat produced in lbs of water raised 10 deg. F.
Cannel Gas . .	3·30	16·50	2·01	217·50	195·0
Common Gas. .	5·45	17·25	3·21	348·25	278·6
Sperm Oil . . .	4·75	23·75	3·33	356·75	233·5
Benzole	4·45	22·30	3·54	376·30	232·6
Paraffine	6·81	34·05	4·50	484·05	361·9
Camphine . . .	6·65	33·25	4·77	510·25	325·1
Sperm Candles .	7·57	37·85	5·77	614·85	351·7
Wax.	8·41	42·05	5·90	632·25	383·1
Stearic.	8.82	44·10	6·25	669·10	374·7
Tallow.	12·00	60·00	8·73	933·00	305·4
Electric Light .	none	none	none	none	13·8

There you see why the electric light is so pure and so healthy. There is no consumption or pollution of air. There is the smallest possible production of heat. There are none of the existing dangers from fire or suffocation, but all is pure, healthy, and safe.

Our homes on the seas—those ocean palaces that render voyages to America and our colonies a pleasant yachting picnic—are being gradually fitted. Over sixty are already so fitted, and all will soon be done. None but those who have tumbled and tossed on the angry ocean in a pitch-dark confined crib for the seemingly never-ending night, can appreciate the peace and comfort of the soft and gentle little glow-lamp that is now supplied.

Efforts are being made to introduce primary batteries for the generation of electric-light currents, but not as yet with marked success. Unless the products of combustion can be sold profitably, primary batteries must necessarily be costly, and their constant renewal, and the amount of personal supervision they demand, militates much against their use, but some admirable batteries for small and temporary installations have been brought out, notably that of Mr. Holmes. Our railway trains are being lighted. Very satisfactory experiments are being made

on the Brighton, South Western, South Eastern, Metropolitan, Midland, and Great Northern Railways, with dynamos, primary and secondary batteries, and there is no doubt whatever of their ultimate success. There is no reason why the energy of the moving train itself should not produce currents of electricity to illuminate every compartment with the light of day.

Exhibitions have been both banes and antidotes. They have had much to do with the cause of the late mania, but they have also encouraged invention, and stirred up emulation. Last year's Fisheries Exhibition did much to educate Londoners to the advantages of the light. This year's Health Exhibition will do more; and I venture to prophesy—a foolish practice unless you know—that this Exhibition will, as an electric light display, be the best we have ever seen.

There have been a good many failures in electric lighting, as there must be in the introduction of every new enterprise, but every failure can be traced to imperfect apparatus, or to the employment of inexperienced contractors—in fact, to bad engineering. It is not long since that the wiring of a large building was let to one firm, and the lighting to another, with the necessary consequence that the whole thing "burst up," to use an Americanism, on the night of opening.

It is difficult to express any opinion on the economy of the electric light. We have not had the experience of any central lighting station of sufficient magnitude to justify the formation of such opinion. Any comparison between gas and electricity on this basis is unfair, because gas is produced in quantities sufficient to supply hundreds of thousands of lamps, while the largest electric light station yet erected does not light up 10,000 lamps. In New York, the price is the same for electricity as for gas, but then gas costs 12s per 1,000 cubic feet, as it did in London, in the memory, perhaps, of some present. Nevertheless, the cost of supplying electricity now is far less than was the cost of supplying gas in the early days of its introduction.

But why draw a comparison? People do not compare the cost of gas with that of candles, nor the price of a pheasant with that of a mutton chop. If we want a luxury we must pay for it, and if the price of the luxury is not too great, people will have it. People will have electric light, if it can be supplied to them, not because it is cheap, but because it is, safe, healthy, pure, soft, and natural. And, moreover, they will not object to pay any reasonable price for it, whatever may be the price of gas. Gas is most destructive, unhealthy, and objectionable when used for artificial illumination. The proper function of gas is the production of heat, and we see in this room how this production of heat can be utilized to form electric currents which diffuse about us a real luxury—pure light. When the electric light can be supplied, questions of sanitation, ventilation, and decoration will determine its use, and not questions of price. At present, for household purposes, it is a luxury for which we must pay; but the progress made is so rapid, and the room for improvement so great, that the day is not far distant when we shall cease to regard it as a luxury, and shall demand it as a necessity. —*London Electrical Review.*

THE GULF STREAM.

WILLIAM HOSEA BALLOU.

Circulation is not confined to the blood of man nor to the currency of a government or bank. It is the essential factor visible everywhere in nature. The network of the rivers is the life blood of land, the winds of the atmosphere and currents of the ocean. It is death to stand long in the snow because the circulation of the system becomes blocked; thus circulation of some kind is necessary to the preservation of all the elements of nature, social and physical. Man dies when the circulation of the blood ceases. The land would similarly die, so far as habitation or cultivation is concerned, if the rivers should cease their flow. The air would similarly die and no longer afford refreshing breath should the winds cease and the cyclones fail to purify it. The ocean without its currents would soon die and its surface be blocked with dead fishes and lower forms of animal life. This earth will remain habitable just so long as these infinite methods of circulation are perpetuated, and when the force we call gravitation fails to circulate the orbs in space, the doom of the universe will be sealed.

The Gulf Stream is the largest and longest body of flowing water extant. We are to regard it as the steam pipe which conveys the heat from the equatorial furnace of the earth to points where the sun is not sufficiently operative. The amount of heat thus transferred is easily estimated at nearly eighty quintillions of tons annually. The evidences of geology exhibit this stream in a fickle light. It has not been constant in its devotion to Northern Europe and England. When it sought other idols, the cold currents flowing south occupied the greater part of the Atlantic and cooled the now moist westerly winds. Then in Northern France the Arctic fox, reindeer, and glutton prowled about. After this, there was a gradual change and the current returned with greater warmth than is now experienced, so that the fig-tree and canary-laurel flourished where Paris now is. Then it was that lions, tigers and elephants held sway in the valley of the Thames, and London was founded by the denizens of jungles. Some one has been foolish enough to express a fear that an isthmian canal would turn this powerful current into the Pacific Ocean, forgetting that the dimensions of such a canal would hardly average fifty miles in width by one thousand feet depth.

There are numerous theories in regard to the origin of this perpetual-motion current. The most ancient supposed the Mississippi river the parent, but it was found that its volume was one thousand times too small for the purpose, although its waters mingle with it. Captain Livingston ascribed it to a sort of yearly tide, conceived by the sun's apparent yearly motion and influence on the Atlantic. Dr. Franklin held that the stream was the reflux of waters piled up in the Gulf by the trade winds, but these gentle breezes only blow about 111 days per year and could not possibly pile up so much water. Besides, water being eight hundred

times heavier than air, it is scarcely presumed that the trade winds develop strength enough for such a task.

Captain Maury next took into account the action of the sun's heat. He believed that the water at the equator was made lighter by the action of the sun and flowed over the surface toward the poles. The cold water of the Polar seas rushed in to take its place, but being heavier, formed a submarine current.

Sir John Herschel maintained that such effects were impossible, since if the waters became lighter, they could only have an upward, downward or sidewise tendency. The latter could only result from the gradual sloping caused by the bulging of equatorial waters. Such a slope was too slight for such an effect.

Richard A. Proctor, the astronomer, next takes the stand and argues for a theory most generally held to-day. He proceeds to show that the great heat of the sun at the equator has a drying as well as a warming effect on the waters. It evaporates enormous quantities. This causes an intense suction to take place over the whole equatorial Atlantic, and a submarine current of cold waters from the Poles results and takes the place of the waters evaporated, also causing a surface flow of warm waters toward the Poles He says: "Having once detected the main-spring of the Gulf Stream mechanism, or rather the whole system of oceanic circulation—for the movements detected in the Atlantic have their exact counterpart in the Pacific—we have no difficulty in accounting for all the motions which that mechanism exhibits. We need no longer look upon the Gulf Stream as the rebound of the equatorial current from the shores of North America. Knowing there is an underflow toward the equator, we see there must be a surface flow toward the poles. This must inevitably result in an easterly motion, as the underflow toward the equator results in a westerly motion. We have, indeed, the phenomena of trade and counter-trades exhibited in water currents instead of air currents."

I protest in the name of every student who attended the district school twenty years ago, that this Proctorian theory is almost the exact wording of that of Francis McNally in his "System of Geography," then studied. Yet at that time, the Royal Geographical Society was questioning the very existence of the Gulf Stream. In brief, our unpretentious geographer, who made but a three-page analysis of the physical features of the earth, quietly advanced the only correct theory of oceanic currents which were only advanced in after years by the great scientists abroad as a result of a regular process of evolution of ideas, given in the last paragraphs. To my own mind, all the causes taken into consideration, which were either accepted or rejected, contribute their quota to oceanic currents. The vast volume of water constantly contributed by the Mississippi and tributaries, must render a portion of the prodigious force and volume of the Gulf Stream possible. The trade winds banking up waters in the Gulf, must add something by the reflux. The bulging of equatorial waters may contribute a little. Of course, the evaporation by the sun is more potent than all other forces combined, but Richard A. Proctor hrs not an iota of claim to priority for that theory.

The equatorial current is not continuous as a submarine flow. The United States Coast and Geodetic Survey, has prepared a map, showing an "inner cold wall" from outside New York to Cedar Keys, by which term is meant the equatorial current, flowing from the Arctic Sea. It is not surprising, then, that the warm waters of the Gulf sweep the bed of the ocean for many hundred and perhaps thousands of square miles. It consequently happens that its bed, as well as the Gulf Stream itself, has a distinct fauna and flora of its own, perhaps the most marvelous in any area of the globe. The dredging and trawl nets of the United States Fish Commission, in this area, have brought up literal thousands of new species of fishes and the lowest forms of animal life. There seems to be no end to the species discovered here. Every year a new section of ocean bed is explored, and a new series of animal life brought forth. The warm waters of the Gulf Stream bringing a constant supply of food and soil from the Gulf and the far interior of the west and northwest United States, makes this a rich field for the support of life. Here, too, have been discovered the breeding and hiding places of large schools of new or long-known edible fishes. One acre of land on the ocean bed touched by the Gulf Stream, is worth a hundred acres of the richest prairie land. The products of this area find their way to Chicago, and may be had at the table in a line of eating houses and dining cars as far west as Salt Lake City. Thus the soil which is lost to the West by the depredations of the Mississippi, is returning its par value with interest to the same West by aiding in the support of food fishes far out in the Atlantic.—*The Saturday Evening Herald, Chicago.*

GEOLOGY.

GEOLOGY IN GENESIS.

PROF. S. H. TROWBRIDGE.

The first chapter of Genesis—not to mention other portions of scripture—is full of geological information; and in its phraseology and general scope is not to be dispensed with in a successful study of the Earth's ancient history. It affords trustworthy data on many points of interest, concerning which, all other sources of information give us nothing but conjecture.

Geologists require a vast amount of time for a physical explanation of all the changes which have taken place in the history of our Earth. And the Bible gives it: For the "beginning" mentioned in the first verse of Genesis, may have been millions of years before the work of the six Mosaic days commenced. But in the beginning, whenever this was, "God created the Heaven and the Earth;" not as they now appear to us, but the *matter* out of which the Heaven

and Earth, or the whole material universe, were afterward to be formed. Modern scientists, in their hunger for a physical cause to every phenomenon, have studied long and hard to account for the first existence of matter and of force. Failing to find in Nature an adequate cause, they are driven to the illogical *supposition* that they never had a beginning. In Genesis we have the only information the human mind has yet acquired as to their origin. Matter was *created.*

In the second verse the Earth, "without form and void," was mixed up in confusion with the other matter destined to form our solar system. This whole mass of matter was in a dead and useless condition, and without any definite shape because it had no force of attraction or motion, no manifestation of light or heat. No force in any form had yet been caused to act upon or through matter. We know that this must have been the condition of things at that time, for we are told that "darkness was upon the face of the deep," (the "deep" here mentioned was not the deep of ocean, for water as such could not then exist, but the deep of chaos). Attractive forces, whether molar, molecular, or atomic, produce motion, motion produces heat, and cosmical heat and light are inseparable. All forms of force are transformable into light, and without these forces light is a physical impossibility. Force, like matter, is held by so-called "modern science" to be eternal, and to be an inseparable accompaniment of matter. Yet here we are taught that matter once existed without any power to attract, repel or influence other matter. It would ever have remained so, and would now relapse at once into its original chaos but for the brooding spirit of God. Force is not a property of matter but an attribute of spirit. When the "Spirit of God moved upon the face of the waters," or hovered with creative power over this unmeasured expanse of dead matter, the particles were made to attract one another and they rushed together producing an enormous conflagration. If, as the chemist asserts, the light of a common fire is due to the clashing of atoms of oxygen and carbon, and the intensity of the calcium light results from the concussion of the atoms of oxygen and hydrogen in the blowpipe, it is easy to conceive that the first collision of all the atoms in the universe would produce no ordinary illumination.

When matter became capable of attraction and motion it was for the first time prepared to obey the command: "Let there be light." Dividing the light from the darkness could not refer to the alternation of day and night due to the rotation of the Earth on its axis, though many thus explain it; for the Earth was not at this time a distinct planet but a part of the nebulous solar mass, and the Sun and Moon were not appointed to divide the day from the night till the fourth day. The term "light" is, without doubt, used here in the abstract as now separated from the darkness of all the past. The passage would, perhaps, be more correctly understood if rendered: And God called the light what we call day, or day-light, and the darkness what we call night.

This ends the first creative Day. At this point in the history of the matter of which our Earth formed a part, it had reached the condition in which the nebular hypothesis first takes it up.

The word "firmament" originally means, not something solid, but an expanse, and doubtless here refers to the open space occupied by the heavenly bodies, perhaps both in and out of the solar system. The word is evidently used in a more restricted sense in recording the work of the fourth day. There it has reference to the space occupied by the Sun and Moon; and in the fifth day, to our atmosphere in which birds and insects fly. As to what is meant by dividing "the waters from the waters," there has been much difference of opinion. While most understand by it the separation of seas from clouds by precipitation of the moisture, and the clearing up of mist in our atmosphere, the idea of Dana that then the "planets were invidualized," and of Mitchell that the matter they now contain was then collected around centers of aggregation, seem more reasonable.

The same difficulty occurs in defining satisfactorily the waters under and and above the firmament. They are commonly understood to mean respectively seas and clouds, and plausibility for this view is given in verse nine when the waters under the Heavens were gathered into one place and the dry land was made to appear. But doubtless the most satisfactory interpretation is to consider the waters under the firmament as the nebulous matter, out of which our earth was formed, separate and distinct from the other members of the solar system, and these as the waters above the firmament. For, from the conditions of the nebulous mass of dead matter uniformly diffused in space just vivified with powers of attraction and motion, and having just manifested the result of its first molecular activity in the first appearance of light. before it had contracted, before a single planet had separated from the parent mass, the transition seems too abrupt to pass all at once to the time when the Earth had already left the solar mass, had concentrated from its original ring, thrown off its Moon, contracted to its present size, and cooled till its aqueous vapor had been precipitated to its surface. Again, if the the separation of these waters referred to the clearing up of mists in the Earth's atmosphere, why should not the Sun and Moon have become visible at once instead of two days later? So slow a progression of events from the second to the fourth creative day seems strangely out of harmony with their rapid progression between the first and second days, of which, if the generally accepted view is correct, Moses makes no record whatever. Hence I conclude that this separation and concentration of matter so as to leave the firmament, or empty space, between the planets of the solar system, was the work of the second day.

As the statement, "God saw that it was good," concludes the record of each day's work except the second, scholars have expended much fruitless labor in their attempts to explain this omission; but as it occurs twice in the records of the third day, Patrick, Bush, and others, claim that verses nine and ten belong to the second day. This would make a more natural division of creative work,—as others without regard to this expression of approval have suggested,—and make the recorded approval of the Creator to conclude the work of each day. If we accept this division, we must add to the changes on the second day the concentration of the gaseous matter of the earth, first to the liquid form, then

to a solid till it resulted, according to the hypothesis, in the elevation of land above the ocean.

After the upheaval of the land, the next thing in natural order would be the utilizing of it, as soon as sufficiently cooled, by the growth thereon of low orders of plant-life. And Moses next records that the Earth brought forth grass, the herb yielding seed and the fruit-bearing tree, following each other in the same ascending order as determined in nature by the advanced paleobotanist. It should be noticed: 1. That the grass is not mentioned as yielding seed; it perhaps refers to sea-weeds, lichens and fungi,—the lowest of plants and the first found fossils in the rocks,—which propagate by means of spores instead of seeds; 2. that the herb is mentioned as yielding seed after his kind; and 3. that the tree is specified as yielding fruit, as if for food. Now the fact that these three groups of plants, evidently representing all the great subdivisions of the vegetable kingdom, were all created on the third day, would lead to the supposition that the work begun on the several days might be only initiatory, and might continue to unfold with higher forms of life during the succeeding days; for geology furnishes us no evidence that all these kinds of plants existed before the commencement of animal life introduced on the fifth day. In fact geology has not yet satisfactorily shown that plant remains exist in older rocks than do those of animals. Yet the presence of graphite, a pure carbon, and so far as known the result of vegetable growth, which is found in abundance in the older rocks, argues the pre-existence of rank vegetation. The presence of iron ore is also considered by some an indication of vegetable life, and iron is especially abundant in the earlier strata. The statement is common that plant remains doubtless exist in the Earth and only await future discovery. But this statement, based as it is upon our ignorance, can have but little scientific weight.

Another supposition, open to the same criticism, is that the conditions necessary for the preservation of plants were not as favorable as for the preservation of animals. This theory, however, has some plausibility because it is well known that the woody structure of plants is far more destructible than the calcareous or silicious shells of animals, and it is only these remains of animals that are usually found. Physiology teaches the priority of vegetable life, for it is essential to animal life, being its universal food. Another question that frequently arises in this connection is: How are we to account for the existence of vegetable life upon the Earth before the Sun appeared, when plants cannot grow without sunlight?

According to the nebular hypothesis, the light and heat from the *nebulous* Sun would have been sufficient to promote vegetable growth, even while it was yet so enveloped in the vapors of its own atmosphere, or concealed by the unprecipitated vapors surrounding the earth, as to be invisible. And, according to the Mosaic record, the light abstract or cosmical of the first day would be sufficient to promote vegetable growth. But it is highly probable as we shall see a little later in discussing the creative days, that, in the panorama of creation which Moses saw, his attention was not arrested by the low orders of plants

which first appeared, but what he records as the creation of the third day was the luxuriant vegetable growth of a later geologic age.

The work of the fourth day consisted in bringing into full view the two great lights understood to be our Sun and Moon. To appear with disks of distinct outline as we now see them, instead of immense masses of nebulous matter, the process of condensation must have been far advanced. Whether the work of this day resulted in far greater condensation than existed at its beginning, or simply in clearing up the mists and clouds in the Earth's atmosphere so as to reveal the Sun and Moon, seems difficult to determine. The former view would seem to make the work more in harmony with that of the other days, as regards the magnitude of results accomplished; while the latter seems more consistent with the facts as we understand them. We could not expect the Moon and Sun to arrive at the same state of condensation at the same time, for we known the Moon, on account of its small size, is now a cold inactive cinder, a "dead planet," while the Sun is still in a glowing state of igneous fusion. But it is not necessary that we should suppose the same amount of time and force to be expended in the work of each day or that the accomplished results should be of equal importance. The only essential seems to be, an event sufficiently striking and important to impress the mind of the inspired writer as one worthy of especial attention and record.

On the fifth day the *waters* were commanded to bring forth the various lower animals. "*Moving creatures*" are understood from the original to be those which rapidly multiply, probably for the most part oviparous. "Fowls" include every flying thing, insects, pterodactyls and other bird-like reptiles. "Whales" include the monstrous saurians of the Reptilian Age, and also, doubtless, sharks, crocodiles, and the like. In the order in which these are mentioned, it is not easy to trace *exact* harmony between Genesis and Geology. Fishes might answer to the moving creatures, as they are among the most productive of all animal life, one fish often depositing hundreds of thousands and even millions of eggs. But several other forms of life appear in the geological record before fishes. Radiates and Mollusks were especially abundant, and Trilobites less so. These may be included in the expression "moving creatures," as well as other peculiarly prolific animals.

As Moses notices only the most prominent points in the earth's history, the few objects he mentions are doubtless typical representatives of many others he passes over in silence. If we reason from other points in this history on which increased knowledge of nature has thrown great additional light, it is safe to infer that *when* we thoroughly understand the affinities of all the lower animals both fossil and living, and their exact relations to one another through a more careful and intelligent study of these forms; and when we have acquired a more thorough knowledge of the Scripture record itself by more profound study of shades of meaning in the original words, and more exhaustive comparison of manuscripts, not omitting, in either line of investigation, the illumination of the Holy Spirit, then we may expect to find that, for their number, the few words

Moses uses are the most comprehensive that could be found, and represent most fully the real relations existing among the lower animals.

While most of the life referred to in the creations of this day belongs to the water and is brought forth in it, this cannot be true, with our present understanding of the birds, though it may be of all other flying things. In verse twenty-one, however, the winged fowl is not included in the expression, "which the waters brought forth;" and in verse nineteen of chapter two we are told that God formed every fowl of the air, as well as every beast of the field, "out of the ground." From this it would be reasonable to conclude that the fowl of the earlier part of this day were not the same as those of the latter. If we consider the first fowl as representing pterodactyls and other bird-like reptiles, and also aquatic insects upon which these reptiles fed, and the last to be reptilian birds of the Mesozoic age, followed by real birds associated with beasts of the field, we have an order of succession exactly parallel with that which we find in the record of the rocks. Moreover, the lack of definiteness in the term fowl, and also its application to both water and land animals, may be a covert indication of the transition from reptilian to bird characteristics in the Reptilian age, as has been shown by Prof. Marsh, and others; and thus evidence the fact that the inspired Word of God, even in its secondary office as expositor of nature, is superior to the latest discoveries of modern science.

The sixth day is devoted to the creation of the highest of the lower animals and, lastly, of man. Like the plants of the third day, the lower animals of this last day are represented as brought forth from the *Earth*. These, no doubt, include the gigantic mammals of the Tertiary Age and all the quadrupeds from that time to the present. As man is the highest of mammals the physical work of this day was devoted entirely to the creation of mammals. The physical part of man, we are told in Genesis ii.; 7, was formed of the dust of the ground. But there was more than a physical creation on this day; and the form of expression relating to it is entirely different. The record represents the Creator as summoning all the powers of the triune godhead in this last and crowning work of all His wondrous acts of creation. Let *us* make man in *our* image, after *our* likeness. While man's *body* was formed of the dust, and in this one thing related to the lower animals,—whether by genetic descent or by immediate creation neither Scripture nor science fully assures us,—this was not all of man. In addition to this, God breathed into his nostrils the breath of life and man became a living soul. This cannot refer to animal life of air-breathing animals, for all quadrupeds possessed this before, and the same statement is nowhere made of them. None of the beasts of the Earth, or of the cattle, or of the creeping things had *this* breath of life. They were never made to become such living immortal souls. No doubt the lower animals have *limited* thinking and reasoning powers, but they have no power of abstract reasoning and no moral sense. They were not created, as was man, in knowledge, righteousness and true holiness after the image of God. Man in the image of God is a spiritual being. God is spirit. It is this spiritual part of man which entitles him to dominion over the lower ani-

mals, many of which have bodies that far out-measure, out-weigh, and over-power his. If men should ever prove that the body of man is developed from that of some lower form of life, they would even then be far from proving a like origin for his spiritual nature; and till they have more marked success in demonstrating the former, there is little ground for fear that they will soon or ever establish the latter.

Authorities differ widely as to what particular geological formations belong to the work of each creative day.

As the plants of early geologic time were marine, and perhaps entirely submerged, it is reasonable to suppose they would not attract the notice of Moses, as the scenes were pictured before his mind's eye, with anything like the vividness of the vast forests of the Carboniferous Age which formed our coal beds thousands of square miles in extent and scores of feet in aggregate thickness. Prof. Dana estimates that "for a bed of pure anthracite thirty feet thick the bed of vegetation should have been at least 240 feet thick." If we compare this thickness with the depth of fallen and decaying vegetable matter on our oldest and densest timber-lands, we can easily imagine how much ranker must have been the vegetation of those primeval forests. If the luxuriance of this vegetable growth was what Moses referred to, the third creative day must correspond with our Carboniferous period. The excessive heat, the great amount of carbonic anhydride in the air, and the thick fogs and vapors which still concealed the Sun, were all favorable to this profuse and dense vegetation.

The first and second days would then be represented by the Archæn, or oldest rocks formed, and the Silurian and Devonian Ages following. In these strata nearly all the remains of life we find are marine and would not impress the mind of an observer. During all these ages, too, the geologic record informs us there was but little land raised above the ocean, and this little was but slightly elevated and was barren of all life but the meanest vegetable forms. At best it would have presented but a most desolate and unattractive picture to an eye-witness. But in the Carboniferous Age the land was greatly extended, and the contrast it presented to the desolation of all previous time must have been peculiarly noteworthy.

During the fourth day, while the atmosphere was being cleared of its mists and clouds so as to reveal the celestial luminaries, the submergence of this profuse vegetable deposit and its burial by the detritus of the sea under thick layers of clay and sand, such as we now find above the coal, might have been going on. Then, when the waters brought forth the swarm of monster "whales" and flying reptiles of the fifth day, would follow in geologic order the Reptilian Age which abounded in just such animals. Following these, the geologic record next discloses the crawling sloth of monstrous size and the other huge terrestrial mammals associated above with the flint implements of pre-historic man, which closely correspond with the creeping things, the cattle, and lastly man, of the sixth Mosaic day.

ANTHROPOLOGY AND ARCHÆOLOGY.

NORTH AUSTRALIAN TRIBES.

PROF. OTIS T. MASON.

Mr. E. Palmer, after having enjoyed exceptional advantages of personal observation, contributes to the Anthropological Society, of London, a paper of great merit on nine Australian tribes, living chiefly on the streams emptying into Carpentană Gulf. Tribal boundaries are known and respected, but there is no individual right of land. When tribes met at a common festival, it was with the consent of the owning tribe; they never hesitate, however, to cross a neighbor's ground for war or blood revenge. The color of the skin varies from black to light brown. The women are healthy, their children precocious. Infanticide is less common than supposed, but abortion is frequently resorted to. The men are stoical and cruel, practice polygamy, and are skilled in deceit. Mr. Palmer enters minutely into their hunting, foods, weapons, arts, ornaments, graphic methods, amusements, beliefs, myths, ceremonies, burial, and healing art.

That which will interest most highly the anthropologist is Mr. Palmer's studies in their class system. Mr. A. W. Howitt reviews his contributions, adding information from other sources so as to make the chain as complete as possible. It may not be known to all the readers of science that the Australian tribes are separated into classes, four, or some other number. The blacks are born into these divisions and they must not marry into their own class or eat the animal which represents it, indeed, they do not like to see any one else eat of their totem. A few specimens of these classes from the simplest to the more complex will illustrate the subject:

	MALE.	MARRIES.	CHILDREN ARE	TOTEMS.
DIERI TRIBE.	Kararu.	Matteri.	Matteri.	Hawk, Lizard, Emu, [Dog, etc.
	Matteri.	Karam.	Kararu.	Kangaroo, Snake, [Rat, Frog, etc.
YERRUN-THULY TRIBE.	Bunbury.	Woonco.	Coobaroo.	Brown Snake, Emu.
	Coobaroo.	Koorgielah.	Bunbury.	Carpet Snake.
	Koorgielah.	Coobaroo.	Woonco.	Whistling Duck.
	Woonco.	Bunbury.	Koorgielah.	Turkey, Native Dog.
MYCOOLON TRIBE.	Marringo.	Goothamungo.	Bathingo and Munjingo.	
	Yowingo.	Munjingo.	Jimalingo and Goothamungo.	
	Bathingo.	Carbumngo.	Marringo and Ngarran—Ngungo.	
	Jimalingo.	Ngarran-Ngungo	Yowingo and Carbumngo.	

In the Dieri Tribe it will be noticed that there are two classes, and that the children take the mother's name. Now Mr. Howitt thinks that all the tribes with four classes have each a still more fundamental division into two main classes, with father or mother right. This is substantially the plan lying at the foundation of our Indian clans. Observe now the Yerrunthuly Tribe. The children are named after their grandparents, that is, after mother's mother or father's father. This method is not found in North America. The Mycoolon Tribe exhibit a still greater differentiation. Here males and females have separate class titles. The boys are named after fathers' fathers, and the girls after their mothers' mothers.

Bearing in mind Mr. Howitt's remark upon the two fundamental, generic classes, and observing whether the boys' or the girls' names are taken from the same fundamental class, we discover that among the Mycoolon the girl is of the same class name as her mother's mother. In the Kamilaroi system, with mother-right, the son is of the same class as his father's father. In other words, says Mr. Howitt, in the Kamilaroi system descent is uterine; in the Mycoolon, it is agnatic. As Mr. Dorsey has shown us that, among our own Indians, the law requiring a youth to marry out of his clan has many addenda, pointing out whom the bride shall be; so among the Australians, it is not quite true that any Koorgielah may marry any Coobaroo. We have primary class, and secondary class, and, in addition, totems. Mr. Wm. H. Flower has been able to give us a table illustrating this in the Kuin-Murbura Tribe:

MALE.	MARRIES.	CHILDREN ARE.
Kurpal—eagle-hawk.	Karilburan—hawk.	Munal—hawk.
Kurpal—laughing-jackass.	Karilburan—curlew.	Munal—curlew.
Kuialla—eagle-hawk.	Munalan—hawk.	Karilbura—hawk.
Kuialla—laughing jackass.	Munalan—curlew	Karilbura—curlew.
Karilbura—curlew.	Kurpalan—laughing jackass.	Kuialla—laughing-jackass
Karilbura—clear water.	Kurpalan—eagle-hawk.	Kuialla—eagle-hawk.
Karilbura—wallaby.	Kurpalan—laughing-jackass.	Kuialla—laughing-jackass
Karilbura—hawk.	Kurpalan—eagle-hawk.	Kuialla—eagle hawk.
Munal—curlew.	Kuiallan—laughing-jackass.	Kurpal—laughing-jackass.
Munal—clear water.	Kuiallan—eagle-hawk.	Kurpal—eagle-hawk.
Munal—wallaby.	Kuiallan—laughing-jackass.	Kurpal—laughing-jackass.
Munal—hawk.	Kuiallan—eagle-hawk.	Kurpal—eagle-hawk.

In this scheme the law of naming is the same in essence, but is more complex. In the Karilbura and Munal there are two female totems and four male totems; while the Kurpal and Kuialla have two male and four female totems. In the subclasses, a modified form of uterine descent is followed in the totems, the line runs as in the primary classes.

Mr. Palmer devotes a large space to the Australian languages, giving vocabularies of seven.

A chapter of great value to the anthropologist is that upon the plants used by the natives of Mitchell and Fluiders Rivers for food, medicine, stupefying fish, weapons, and manufactures, 104 species in all. Once in a while a report of this kind is made, and it always arrests attention. Just about the time Sir John Lubbock's discussions upon the amount of land necessary to support a savage were becoming well known, our own Government-surveying parties began to send to the National Museum specimens of all the foods used by our aborigines. No one can look at the long rows of jars containing these foods without realizing that the great Englishman left out a large factor in his problem. The same fact appears from Mr. Palmer's lists. The Australians eat roots, bulbs, rootstalks, stems, leaves, stalks of flowers, buds, skins of stems, fruits in endless variety, and seeds. They eat some of them raw; others roasted, steamed, or macerated; and poisonous plants are subjected to a series of soaking, steeping, mashing, roasting, grinding, and baking that completely destroys the noxious quality and furnishes a wholesome food. Five of the plants named are used to sicken fish. Those set down as medicines are used as veritable drugs and not as sorcerer's charms. The list includes crushed leaves, bark, and flowers, soaked or steeped, and applied externally for a poultice or bathing, or the water is drunk. The *Eucalyptus pruinosa* bark is bruised and wound tightly around the chest, being kept damp with water. The patient also sits in a decoction of the plant. The young black fellows rub their faces with *Drosera indica* to make their whiskers grow. Eighteen plants are mentioned as furnishing material for cordage, cloth, nets, boomerangs, reed spears, shields, etc.

DR. SCHLIEMANN: HIS LIFE AND WORK.

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He has again visited the Troad; he has again hired laborers, and lived in tents, and brought with him great experts, in order to clear up and verify what remained obscure and doubtful in his former investigations. The main difficulty in his mind was the apparent smallness of the early city which he found to have been burned, and which seemed certainly the city which gave a basis and a local habitation to the traditions embodied in the Iliad. The gold found there implied considerable wealth; all the legends pointed to the spot having once been occupied by a powerful and civilized people, and yet there seemed no room for them. His new book gives us the natural solution. He had mistaken the acropolis of the "second city" for the whole of it. His architects proved to them that there had been an extensive lower city around the "Pergama of Priam," which was also burned in the great catastrophe, but was not resettled or built on again. From that time small and obscure descendants occupied the royal site, and left poor and shabby traces of their life. It was not till the successors of Alexander enlarged and beautified the town, and the Romans, with

the sentimentality of vulgar upstarts, began to parade Ilium as the home of their ancestors, that another important town marked the persistent site.

Moreover, he had also failed to distinguish clearly the second and third layers of remains on this ever re-established site, for the settlers who came after the great conflagration did not level more than they wanted, and the old buildings here and there reach up through the stratum produced by the third settlement. Again, what he calls the sixth city was not marked by a layer of soil, but only by a large assortment of very peculiar non-Hellenic pottery, which he had called Lydian, but which he now declines to call by any name, while insisting upon the fact of its presence and peculiar character. The outcome of his long labor is, therefore, briefly this: on the site of Hissarlik, and there only in the Troad, there are piled up one upon the other a great series of human traces, reaching from the most remote antiquity into the decline of the Roman Empire. These human traces were separated into periods, in that each of them is covered by a more or less distinct layer of earth and ashes, upon which the next is laid. There are at least six of these layers; and what is most important and remarkable, only the topmost (sixth or seventh) is of what we call a historical character. It alone shows the distinctly Hellenic character in both its pottery, its utensils, and its buildings, and reaches a very little way (not more than six feet) into the earth. Nevertheless, we know that a small Greek town existed there for at least six centuries before Christ. If, then, the remains of such antiquity reach down to only six feet under-ground, what shall we say of the antiquity of the older settlements, which are to be traced down to fifty-two feet under the present level? The mind recoils somewhat aghast from so gigantic a computation. But the character of these older remains corroborates our conclusion. They all bear a distinctly prehistoric character. There is no trace of coinage, of writing, of painting on terra cotta, nay, in the deepest layers even the potter's wheel seems hardly known, and the wares are of the rudest hand-made description. The closer details as to these successive layers of pottery are very clearly given in a remarkable letter from Rudolph Virchow—a European name—and printed (pp. 376 *et seq.*) in the new volume. He there shows "that there is no place in Europe known which could be put in direct connection with any one of the lower six cities of Hissarlik." And again, after describing the character of archaic Greek pottery, he adds: "Seeing, then, that this highly characteristic archaic pottery is totally absent in the deeper strata in Hissarlik, we are at a loss to discover what in all the world is to be called Greek in them. With equal truth might many kinds of vases from Mexico and Yucatan, nay, even from the river Amazon, be called Greek." This is in answer to the ignorant people who attempt to assign late historical dates to all the successive settlements, save one. The non-Hellenic, if not pre-historic, character of these rude wares is singularly illustrated by comparing them with the oldest pottery our author found at Mycenæ. In the latter, though there can be little doubt that their date is not later than ten centuries before Christ, we find the unmistakable character of Hellenic work. They are the direct ancestors of the splendid vases imported to

Italy, and copied in Etruria. This fact in itself makes all skepticism as to the antiquity of the remains at Hissarlik impossible, except on grounds of ignorance. We have heard in our own day of respectable scholars who are still skeptical about the deciphering of the Egyptian hieroglyphics, and the cuneiform writings of Asia. It is quite useless arguing with such people. All one can do is to beseech them to examine the evidence without prejudice, and to examine the evidence they must, of course, learn something of the subject in hand. It is not enough to have read Homer, or Curtius's *History of Greece*, or to have gone to the Troad as a tourist, and to have seen the place. Archæology is a special study, infested no doubt by amateurs, but requiring honest and serious attention.

The demonstration that there existed on the site always recognized in class-days as the site of Troy, a very ancient and important city, with a citadel and such wealth that considerable remnants of gold were lost or forgotten in its ruins —a city, moreover, destroyed by a great catastrophe, and burned with fire in such a way as to preclude all accidental misfortune—makes it almost certain that the poet or poets of the Iliad, whatever historical basis their story may have, certainly attached their stories to this site, and that the memory of this great conflagration had, in some way, survived up to the time when the Iliad was composed. This, again, forces us to place the origin of this epic poetry, at least of the shorter and ruder attempts which preceded the Iliad, at an early date. The brilliant theory of August Fick, that these poems were first composed in the Æolic dialect, and then imperfectly recast in Ionic, falls in with the same argument. But we must not enter into learned discussions in this paper. It is right merely to allude to these literary and historical questions to show how important is the light thrown by Dr. Schliemann's excavations on questions which have hitherto been disputed on purely bookish grounds. Those who wish to have a large and clear view of the general course of enlightenment which our early history of Greece and Asia Minor has undergone from archæological sources, will turn to the brilliant preface with which Professor Sayce has introduced Dr. Schliemann's new volume, *Troja*.

We have often tried to induce Dr. Schliemann to dig on Hellenic sites, but his proper task and the general direction of his studies is to investigate pre-historic antiquity. For this purpose he has not only made his magnificent venture at Mycenæ, of which the results are recorded in a special work, and exhibited in the splendid collection of gold and silver ornaments now at Athens; he has also investigated the alleged home of Ulysses in Ithaca, the great tomb-measure-house of the legendary kings at Orchomenus, and some other less important sites. These researches have conspired with sundry discoveries of pre-historic tombs in Attica, and of archaic art about Sparta, in modifying considerably the current notions of early Greek art and its development. This is the most important outcome of Dr. Schliemann's work, and that to which we desire to call special attention. It used to be a favorite theory among scholars, and is no doubt very common among those who confine themselves to a grammatical study of Greek texts, that the Hellenic race was perfectly original in its art, that the

peculiar character of their architecture and sculpture, and painting was their own invention, and due to no foreign source. The old legends of Cadmus and Agenor and Danaus bringing the arts from the east to the south were rejected, and Greek art was considered to be purely *autochthonous*, as the scholars were pleased to disguise the term indigenous.

What has been now found to be the real state of the case? The historical Greeks have been everywhere preceded either by Greek ancestors, or by some kindred race who possessed both wealth and ingenuity, and had advanced no small distance both in the useful and the ornamental arts of life. Let us take, for example, the great stone buildings of Mycenæ. Here we find enormous stones squared, or even shaped into curves, so as to form the inner surface, perfectly regular, of a great bee-hive vault. We find heraldic sculpture used over their gates, and such massive defenses as must have mocked any assailant of those days. When Dr. Schliemann found the royal tomb within these walls, he found a vast store of ornaments, and vessels not only beautiful in shape, but delicately and gracefully ornamented, while the sculptures on stone and the gold masks on the faces of the dead were rude and ugly in the extreme. The general character of these ornaments could not be called Greek; it was strictly pre-historic, barbarous, if you please; nor could it be called Oriental; but there were not wanting traces of Oriental influence and cases of Oriental (including Egyptian) manufacture. A portion of an ostrich egg proved beyond doubt the existence of a trade with Africa. Engraved gems of strange designs pointed unmistakably to similar Babylonian or Hittite ornaments. And if we had fuller knowledge of the early art of Asia Minor, there can be no doubt that we should find the Mycenæan art was more imported than original. Not that we mean to deny the originality of the Greeks. We desire rather to correct the meaning attached to the word originality, and insist that in both art and literature pure invention is both rare and unsuccessful, and that true greatness consists in the genius of adapting and perfecting the forms or ideas handed down from earlier minds. There are some productions in which perfection of form was very early attained. The earliest and rudest pots are generally very ugly and clumsy imitations of a female human figure, sometimes of birds or beasts, and so long as this fashion persisted, no beauty was attained. But no sooner was this idea abandoned, and mere curves studied with the aid of the wheel, than we find shapes as graceful as any that can be designed in the present day—nay, superior to most of them. This is very remarkable in the gold jugs found at Mycenæ, and which, though of very perfect workmanship, are undoubtedly of great antiquity. And here not only the shape, but the decoration of the surface, is both ingenious and beautiful. In terra cotta ware the surface decoration was slower in coming to perfection, but the shapes of many of the vessels found in pre-historic sites are not to be excelled. There was one vessel found at Mycenæ made of some kind of alabaster, and probably imported from Egypt, which at first sight looked for all the world like a Renaissance vase, the rim being actually a waved circle. The reader must go back to the earlier *Ilios* and *Mycenæ* of Dr. Schliemann for examples to

verify our statements. All his former researches at Hissarlik, and even his last visit and further excavations, did not, however, satisfy the indefatigable man, who undertook in May, 1881, a journey through the Troad, very graphically told (pp. 303-348) in his *Troja*. He wished to see whether there were any other prehistoric sites worth excavating, and also what could be made out about the geography of the country as described by Strabo. But, all through, the keen interest of the traveller, loving to talk with and understand the natives, and enthusiastic at the sight of natural beauty, gives life and beauty to the narrative.

*   *   *   The example of Dr. Schliemann ought to lead the way to similar enterprises. Already the Dilettanti Society have added to the glories of England by their costly and conscientious publications of Greek antiquities; already the German government has shown what can be done with a very moderate outlay, intelligently directed, at Olympia, and still later at Pergamus. Let us hope that among the many men who have inherited fortunes far beyond the requirements even of luxury, some will apply their wealth to this very noble end.

For a noble end it is to inquire into the rudest remains of long-departed races, and to inquire not by theory and conjecture, but by an examination of actual facts. The pure savage attends only to the wants and pleasures of the day, and when the sun sets, has no desire but to sleep. The higher men rise out of this condition, the wider their sympathy with remote and bygone members of their race, the more do they prolong into the night the interests and pursuits of the day. This it is which has ennobled civilized man; this it is which has given dignity to the poorest and narrowest conditions of life.

But now that he has been advised to abandon his arduous labor and devote his remaining years to a better care of his delicate health, he can look back on all these distinctions as only the index of his real desert—that of having added permanently to human knowledge. What a cloud of conjecture and hypothesis has he removed from both Troy and Mycenæ? For if his discoveries have in turn given rise to many controversies, they are controversies about the interpretation of facts, not about the respective probability of rival theories. He has proved what modern skeptics were coming boldly to deny, that the old legends of the Greeks had a local attachment, and were based upon facts in past history. He showed that the sites of cities are permanent things, which men will not surrender even after violent catastrophes, and that we may always seek the old under the new. The growth of legends about tombs of great men is particularly interesting, for it can be paralleled in the legendary history of other and distinct branches of the Aryan race. Above all, he has added a great store of facts for the comparative study of pre-historic man in the south of Europe. We are now beginning to see the general features in the industry and the ornaments of primitive men, and the curious truth that the pottery in all the pre-historic strata at Troy, up to the verge of the Greek remains, is perhaps less like these remains than it is to the pre-historic pottery of Italy, Germany, or even Peru, shows that we may yet attain to a general view of the state of man under certain conditions of life.—*Harper's Monthly for May.*

METEOROLOGY.

BIRTH OF THE TORNADO.

CAPTAIN SILAS BENT.

The prevailing winds of the Basin of the Mississippi are from the westward; being from the northwest in winter and from the southwest in summer.

The westerly winds are cold, dry and compact, or heavy; whilst the southerly winds—especially if coming from the Gulf of Mexico—are warm, moist and diffuse, or light.

This marked meteorological difference in these winds, forbids their ready or fluent commingling, but on the contrary, in fact, rather establishes a vital antagonism, between them, which leads to dire conflicts for supremacy wherever they encounter each other during the transition seasons of spring and autumn; at which times, the atmospheric convulsions are often so great as to culminate in most destructive storms.

When these encounters take place, the north wind, owing to its greater specific gravity, wedges under, or under-runs the lighter south wind and is thus placed between the warm earth below and the still warmer south wind above, and feeling the impulse of its increasing temperature, begins to expand, but being still pressed onward by its own volume in the rear and finding no escape, its travail begins.

Meanwhile, its own chilling effect upon the humid atmosphere above condenses and wrings out from the latter, torrents of rain. This rain in turn, however, is not unfrequently converted into heavy hailstorms before it reaches the earth, by the rapid evaporations to which it is exposed in passing through the cold, dry stratum of north wind beneath.

The struggle thus begun, continues until the underlying cold wind finds a weak spot in the stratum above, through which it makes a breach and bursts forth with an upward force, proportioned to the pressure it is sustaining.

An opening once made, the rush of the surrounding air towards the central outlet—obedient to physical law—assumes a rotary and upward whirl, the vortex of which is a vacuum, but whose substance becomes a writhing column of wind, water and electric fire; with its base resting upon the earth, but whose summit reaches above the contending winds; and the TORNADO has sprung into existence, ready to start on its brief but terrible career of destruction and death!

In addition to this whirling movement—the velocity of which is beyond computation—the tornado at once takes place on an onward or progressive motion over the earth's surface, whose path is probably the resultant of the relative

strength and directions at their impact, of the original winds to which the tornado owes its genesis, and which path it pursues until the equilibrium of the atmosphere is restored.

ST. LOUIS, MO., April 12, 1884.

METEOROLOGY REVOLUTIONIZED BY THE WEATHER-MAP.

ISAAC P. NOYES.

No department of Science was ever revolutionized to a greater extent, by any one step, than was meteorology by the Weather-Map.

Prior to the discovery of the Western Hemisphere the world knew little about the geography of the globe. Till science had advanced and given us the telegraph and all the details necessary for the complete Weather-Map we knew comparatively little about meteorology.

At first it may seem strange that such should be the case, yet the intelligent world will admit that we cannot know much about any subject until we have full and complete facts, and that meteorology is no exception to the rule.

The Weather-Map opened a new field, replete with facts, which all these years were unknown to us.

In order to have a Weather-Map of any value, we must not only have an extended territory, but that territory must be under the jurisdiction of one central head. In this respect the United States is particularly fortunate. Three times daily, at 7 A. M. and 3 and 11 P. M., the reports are sent in from all parts of our extended country to the central office at Washington. From data thus collected, the daily Weather-Map is created and the "indications," daily, morning and evening, telegraphed to the press of our cities and towns.

Prior to the advent of this Map we were dependent upon the branch of science known as "physical geography" for our knowledge of meteorology; now the fact is revealed to us that the old system could give us but little practical information. We will not however complain of this old system, or its teachings, prior, say to 1875, or before the Map had become the perfect thing that it is to-day; but from 1875 on, to date, it is surprising that the new system has been so much neglected.

Although the Map, in the United States, was established about 1870, its first editions were quite crude and it necessarily took a number of years to arrive at the perfect work of to-day. Some may think the progress slow, but when we come to consider the difficulties in the way, the little moral support this institution has received from the public and the general lack of interest whereby generous appropriations become practical and available, the wonder is that the subject has been advanced even to its present condition.

In the old system there was necessarily too much dependence upon the deductive principle; in the new we have a fine illustration of the inductive prin-

ciple. In the topography of the country we have the hill and valley. Although these combinations form only two factors the diversity of landscape which they produce is infinite.

The atmospheric counterpart of the hill and valley is high and low barometer—technically called "High" and "Low." These terms the reader should bear in mind. "Barometer" is a long word, so in the phraseology of the Weather-Bureau it is dropped, and the words "High" and "Low" respectively stand for high and low barometer.

The terrestrial hill and valley are quite permanent—as a mass they may be said to be permanent. The mountain chains and hills and the valleys remain about as they were when man first inhabited the earth; but not so with the atmospheric hill and valley. They are ever changing; never twice alike. They are as varied as the clouds, and in their variety they more resemble the kaleidoscope than anything else. These changes, from hour to hour, day to day, produce what we term "the weather." They are ever on the move, on general lines, from the west towards the east. We live on a globe; the heat which sustains life thereon comes from the Sun, but this heat alone will not sustain life. The body that receives the benefit of this heat must be in condition to appropriate it to a good advantage. Satellites have not this power or quality—planets have. Through the Weather-Map we are enabled to understand the important part heat plays in the economy of Nature as never before. From the old system we learned about the seasons and their general cause, but before the advent of the Map it was impossible to explain these peculiar lines of heat and cold which are independent of latitude and of the position of the sun in the ecliptic. We could not explain why the isothermal lines at times run from the extreme northeast to the southwest, or from the southeast to the northwest. Why it was sometimes as warm in New England as in the cotton States. Why cold in New England while it was very warm in the region of Dakota and Montana. Why some localities at times suffer from drouth while others are abundantly supplied with moisture.

Under the old system they even did not know what a storm was; they had no conception of storm centres and where one storm began and another ended.

If it rained two or three weeks in succession it was thought to be one protracted storm, while on the contrary it was the result of a series of storm centres passing over the country. Neither could the old system explain the tornado, hurricane, or cyclone, call it what we will. It could not satisfactorily explain numerous phenomena connected with this department of nature—all for the simple reason that the facts which the Weather-Map has revealed to us were then inaccessable. If we will heed the teachings of this wonderful instrument, which may well be termed "The Geography of the Atmosphere," we will understand this department of Nature as never before.

The Map reveals the fact that the areas of high and low barometer are al the while passing over the earth's surface, in belts and on general lines, from the west towards the east. From this it must not be understood that they move on parallels of latitude, nor even take quite straight courses across the country, for

they do not; on the contrary they move on very irregular lines, and at times take a direction of 45° and even 90° to the parallel of latitude. Sometimes taking a northeast or a southeast course, zigzag, like the letter W; and they even at times travel due west. But whatever their local direction; their *general course* is the while from the west toward the east, or towards the rising Sun. The changes are infinite: "Low" being the governing factor, it is necessarily the one about which the most may be said. It may be asked,—What is "Low"?

There is no branch of science but what leads up to some unknown power or cause. In meteorology "Low" is the great unknown. We know that it exists. We know how it passes over the country, and know its effects. But why should it obey the law it does? At this point I shall submit a theory, the only theory about the whole subject. I do not claim for it more than its name implies, "a theory," and I have no desire to hold to it if unsupported by reason and fact, and am ready at any time to accept a better reason or explanation whenever offered.

"Low" is the concentration of the Sun's rays, and may well be illustrated by the double convex lens, commonly called a "Sun-glass," when passed over a paper and so held as to focus the rays of the Sun. We will the better understand the theory by imagining ourselves to be present when the well formed earth is started in space.

The surface of the earth is varied. This feature necessarily causes unevenness of latent forces when the heat of the Sun is caused to concentrate on some one favored point. The heat acting on the water is the while forming clouds. The concentration of heat causes rarification of the air at this point—Nature's attempt to form a vacuum. The cooler surrounding air rushes in to fill the place of the rarified air; a current of air, called wind, towards this point, is the result. This brings the clouds that have formed, from all points of the compass, towards this center. These clouds not only precipitate and thereby help cool the surrounding air, but they shut off the heat from the Sun. The heat from the Sun then concentrates on another point a thousand or two thousand miles distant, and the same result follows—around the world. The next day when the Sun reappears in the east the first "Low" is drawn towards the new, or last one, which relatively lies to the east—call it No. 12. No. 2 is drawn towards No. 1; No. 3 to No. 2, etc. Thus the "Lows" travel till they form well established belts around the world. Between the "Lows" are located the "Highs."

If "Low" is the concentration of heat and thus moves along the earth's surface, the question may be asked, why does it not, after mid-day, travel towards the west? It does at times, and is at all times undoubtedly retarded in its course towards the east. Whether this theory is true or not we cannot deny the fact that "Low" travels as it does, on general lines, from the west towards the east or towards the rising Sun.

The surface movement of the wind is towards this center. But as the winds coming from the four points of the compass react upon each other, their direc-

tion, as they near the centre, is that of a spiral curve rather than a straight line. The heated air at the centre of "Low" ascends in a like manner as boiling water. The clouds brought by the winds generally precipitate before they reach the centre, but not always.

At times when a storm-centre is near us, yet not as near but what the clouds are a little broken, if we will look heavenward we will see other lighter clouds travelling in an opposite direction from those near the surface. These upper currents are caused by the ascending currents at "Low," rushing outward to fill the space on the upper part of the column of air in the regions of "High." So we have "Low" moving in great horizontal circles along the earth's surface, and in combination therewith the atmosphere moving in great perpendicular—hoop-like—circles towards the track of these horizontal circles.

The air from the bottom of "High" is being drawn from to supply "Low," when it ascends and travels back to supply the top of the column "High," from whence it was drawn. Thus the round of motion of the atmosphere, and thus Nature's plan to keep the air we breath in healthy activity. Man in his small way can never hope to equal this grand plan of Nature.

If we were unacquainted with the peculiarities of Nature we would be apt to think that the nearer we were to the equator the warmer it would always be. It is generally warmer, that is, the general heat of the tropics is greater than that of the temperate zones, and yet we know that it is oftentimes hotter from 45° to 50° N. Latitude than at or near the Equator. Before we had the perfected Weather-Map this phenomenon could not have been explained, but now we not only can readily explain it but we can the better understand the infinite wisdom in having it so.

The Earth is far more productive in consequence of the laws that govern the concentration of the heat of the Sun, causing "Low" to frequently travel on very high lines of latitude, whereby the necessary heat for the propagation of plants, vegetables and fruits, essential for the existence of high animal life is extended so far from the Equator.

There are portions of our earth's surface which never receive any benefits from "Low," and these are desert places where there is no water present. There is no heat in the earth, at least along its surface; all the heat we have we derive from the Sun. Desert places during the day are heated more readily and to a greater degree than where there is an abundance of water present, but they become very cold during the night. Between sunset and sunrise they lose the greater portion of the heat they have received during the day. Wherever there is water sufficient to generate clouds a more even temperature will be maintained than where there is no water. "Low" will not stop over night where there is no moisture. The clouds, including all moisture in the air, act as a canopy, or an agent to retain the heat, so in order to convert a desert into a fruitful country, one that will be visited by "Low," we must introduce water in some way, sufficient at least to grow hardy trees and shrubs.

The Map proves that the winds blow in general lines towards the "Low."

This being the case it necessarily follows that if "Low" is on a high line of latitude, say 45° to 50° N., we will have south winds, which are warm. If "Low" is on a low line, say in the Cotton States, to the north thereof we will have cold north winds. "High" representing the atmospheric hill, there is no movement of air towards it; so no warm air, or more than relatively warm, can be present in the area of "High" and the atmosphere there must necessarily be relatively cool.

It will be seen that what warm "the wind," and the movement of "Low," which produces the winds, are quite different forces; yet it is often asked if the speed of "Low" is caused by the power of wind. The wind is dependent upon "Low" and not "Low" upon the wind.

Although "High" follows and surrounds "Low" it does not do so in any regular manner. Nature in this department is very irregular, and the Weather-Map which is, as it were, a photograph of these changes of the atmosphere from hour to hour, plainly reveals this, and shows that "High" follows and moves with "Low" over the country; entering *generally* at the west, locally from the south to the extreme northwest, and that the two pass over the country in all conceivable shapes and on all sorts of lines.

We may imagine the whole of the atmosphere as a great sea of "High" with the valley "Low" moving through it. Sometimes alternate areas of "Low" and "High" pass from the west towards the east; sometimes the "High" will be in the north, the "Low" in the south; the "High" in the south and "Low" in the north, or additional variety be given by combinations of these factors. Then this variety is still increased by their size, shape and speed as they pass across the country.

When we have made ourselves familiar with these forces and their movements we will be prepared to understand the peculiar features of the weather—why it is hot at the north while cool at the south—why one season is cool, wet or dry, another hot and dry, or even wet; no matter what the weather may be, the Map satisfactorily explains it all.

"High" and "Low" travel in irregular belts. At times we will have "Low" in the north; "High" central, and another belt of "Low" to the south. This neutralizes the effects of heat and cold. Take away the north "Low" and it will be very cold in the south, and in winter, the Gulf States be apt to have a snow-storm; take away the south "Low" and it will be very warm throughout the country. During the winter and spring we generally have more south "Lows," and "Lows" which travel from the southwest to the northeast, than in the summer. But there is no regularity about it. A so-called "northeast storm" is the result of a southwest "Low," or an area of low barometer advancing from the southwest.

When a storm-centre is to the west of a locality that locality will have an easterly wind, and when the centre has passed to the east a westerly wind will follow in its track, west, southwest, or northwest, depending on the line on which the "Low" is travelling.

Whether the storm produces rain or snow depends somewhat on the season, but more especially on the latitude of "Low."

Local storms comes from the confines, or outer lines of the passing "Low," and mostly occur during the warmer month when "Low" is on a high line of latitude, or when there is not any very well-defined centre. A tornado is a severe local storm which occurs in the track of "Low" and generally when "Low" is on a high line, or passing to a high line.

It would require too much space to enumerate all the changes. A close observation of the Weather-Map for a season will explain all. When we have become familiar with this map we will readily see the absurdity of the statements made by the so-called "weather-prophets." They often say "it will be pleasant or stormy." "When?" is the pertinent question, for we see that it all depends upon the location and relation of these two factors "High" and "Low." It may be very stormy weather in one section and not in the other. Until the "weather-prophet" can locate his storms and give us the positions of "High" and "Low" he had better remain silent; and if he remains silent till then, he will be forever a silent man.

At present the territory from Nebraska to the Atlantic Coast is well supplied with stations, but from there to the Pacific we have very few, and these far apart. As most of our storms come from the west it would be a great advantage to us to have more stations in this locality; not only due west but well to the southwest and to the northwest, from Lower California to the British Possessions.

A few storms come from the south. We should, therefore, be prepared to have ample warning in regard to them, and have stations through Mexico and one or two sea-stations in the Gulf of Mexico, and a few more on the West India Islands. We need protection from the west generally; that is, give the most generous interpretation to the term *west*, for these storm-centres as they pass around the world are liable to travel, as we often see them in the United States for a distance of 1,000 or 1,500 miles due north. We should be prepared against these erratic or occasional ones as well as against those of a more regular course which enter our territory by the regular west-gate.

Most of the "Lows" that pass over the United States pass to the northeast, either through the St. Lawrence Valley, or somewhere between there and Cape Hatteras; hence the prevalence of fog and stormy weather off this northeast coast.

More interest should be centered on this subject. When this is done it will not be difficult to obtain more stations in the localities where they are so much needed.

There is a bright day ahead for this despised branch of science, and when it arrives our Weather Bureau will become one of the most influential branches of government, and one we will support in the most effectual manner, because of the practical benefits we will derive from its more perfect state. The Map will open to us new avenues of pleasure and interest; and when its beauties and prac-

tical value are fully understood we will begin to realize the revolution it has wrought.

WASHINGTON, D. C., April 2, 1884.

A REMARKABLE HAILSTORM.

S. A. MAXWELL.

At 9 o'clock on April 1st, a hailstorm visited this section, so remarkable in some respects that I thought a short description of it would be of interest to the readers of the REVIEW.

The preceding day had been remarkable for a rise in temperature from 38° in the morning to 64° at 3 o'clock P. M. At 9 P. M. the temperature was 54°. The wind on the morning of the 31st was from the east, but at 9 o'clock it changed to the south, from which direction it blew quite briskly all day.

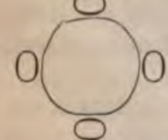
Early on the morning of the 1st there was a light shower with east wind. This was followed by a fog and light sprinkles of rain until 8:50 A. M., when the clouds became so dense that it was difficult to read ordinary print on account of darkness. At just 9 o'clock rain began to fall and five minutes later the hail was first noticed.

The largest stones were three and a half inches in circumference, and their shapes were so varied and extraordinary that the storm must certainly be called the most wonderful ever occurring here.

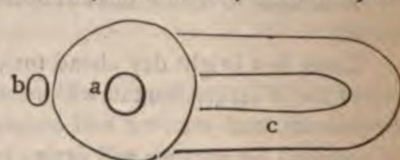
First, there was the ordinary spherical form,—some of these being entirely transparent, and others containing masses of snow at the centre.

Secondly, the lens-shaped stones, some nucleated and others not.

Thirdly, what I would call the *condyloid* form, since it resembled a button. It would have been lens-shaped but for two circular creases on the opposite sides. Outside of the crease the stone was of unequal transparency, lines of white seeming to diverge from the crease to the circumference; but when these were looked at edgewise they were seen to be circular. The following diagram



illustrates the form of a fourth variety. This is but a modification of number two, the lens-form. Number five was the most remarkable of all, and if any scientist can account for its form I would be pleased to hear from him. It is a modification of the so-called condyloid form, and this very accurately represents the form of about one-tenth of the large stones that fell here during the storm.



The part marked "a" was usually one inch across, one-third of an inch thick and usually with a nucleus of snow. "b" is a small, thin appendage, while directly opposite was a curious plate of ice "c" one-

fourth of an inch thick, the margin (being marked with lines as above described), resembling a horseshoe. The center of this part was thinner and transparent.

Of eighteen large stones picked up, two were spherical, thirteen lens-shaped, two with horseshoe attachment and one like number four, which might be called the *crucial* form. Of these eighteen hail-stones only seven had nuclei. Some of them also had a peculiar roughness, comparable to that on the rind of an orange, which I think I have never observed before.

More than an hour has now passed since the storm ceased, yet from my window I can still see a few of the hail-stones that have been diminished to the size of a pea by a temperature of forty nine degrees.

MORRISON, ILL., April 1, 1884.

RUSSIAN FRUITS FOR AMERICAN PRAIRIES.

PROF. A. E. POPENOE.

A bulletin lately received from the Iowa State Agricultural College is occupied by the account of Professor Budd's "Experiments with, and Investigation of, the Fruits, Trees and Shrubs of the North of Europe." In the search for varieties of fruits adapted to the trying extremes of climate met in Iowa, Professor Budd was led, several years since, to look to the north of Europe for varieties not then on our list, in hope that they would prove better adapted to the needs of the northwestern horticulturist than the fruits originating in the moist equable climate of the countries along the western European coast, the latter sorts having been found wanting when subject to the severe tests of the Iowa winters and summers. In company with Mr. Charles Gibb, of Abbottsford, Quebec, Professor Budd visited the interior of Russia at points where fruit-growing was extensively and profitably engaged in, and in climates resembling, in high, dry winds and changes to the extremes of temperature, those of the northwestern states in the Mississippi Valley. Portions of the reports of these two horticulturists are of such interest to the Kansas fruit-grower that they may be here quoted. "The east European plain, the counterpart of our western prairies and plains, covers the larger portion of continental Europe, or the northeast. * * With the Caucasus and Carpathian mountains on the south, the prevailing winds prevent the moisture of the Caspian and Black seas from benefiting even the provinces nearly adjoining them; while the dry winds of the deserts and sterile steppes of the southeast shrivel the foliage of trees and plants in Central Russia, as do our southwest winds from the dry plains of New Mexico. * * As to sudden changes of temperature and humidity of air, our one summer's experience favored the idea that changes of the wind brought atmospheric changes as sudden and complete as with us. As to winter changes, we are told at Tula of a winter, twelve years ago, when a warm, south-

east wind, taking off all the snow, was followed by a northern down-pour, running the thermometer down to forty-five degrees below zero."

In the province of Kazan, on the upper waters of the Volga, and about 430 miles east of Moscow, the peasantry and some landed proprietors are largely engaged in apple-growing. An orchard thirty years of age is described as consisting of six varieties, fall and winter sorts, fourten feet apart, and standing not over fifteen feet in height, the largest measuring only five inches in diameter. The conclusion was reached by the observations made in the province named, that the varieties there so largely cultivated will be found profitable in Dakota and Minnesota. In Simbirsk, where "every available spot is planted with apple, pear, plum, and cherry trees, the summer air is as dry and hot during the day as that of Iowa. The extreme winters, which come as with us at intervals of from six to eight years, are colder than in any part of Minnesota," the temperature of fifty below having been experienced in 1877.

Orchards of 12,000 trees, ninety per cent of them winter varieties, are found at Saratov, and Professor Budd remarks with surprise the systematic management of the orchards, as well as the large, fine-looking fruit produced by them. He states in seasons of unusual drouth the orchards are watered to carry the fruit to maturity. Irrigation is here managed by flowing the water in wooden troughs, supplied by a large reservoir, to basins at the foct of each tree. These reservoirs are kept filled by steam pumps. Worthy of special note was found the system of forestry under the control of the government, the plantations of trees ranging in size from 18,000 to 21,000 acres each, under the oversight of trained foresters, and consisting of Scotch pine, oak, birch, basswood, or elm, in separate tracts, mixed planting not being favorably regarded.

Concerning the much lauded Russian mulberry, it is said to kill back in severe winters, and reports of its use in Russia as a timber-tree are without foundation, unless in the extreme south. Apples were found which were compared by the observers named to our Grimes' Golden, Dominie, White Winter Pearmain, Limber Twig, and other standard sorts, but of better keeping quality and greater vigor of constitution; pears of good quality, perfectly hardy, and, as Professor Budd thinks, capable of resisting blight more or less fully; cherries and plums of superior quality and of great hardiness; and many beautiful and hardy additions to our ornamental trees and shrubs, as well as to the list of profitable trees for forest-planting on our western plains. In a letter to the writer, Professor Budd says: "Our work is not confined to the far northern fruits. The idea is to get the fruits, shrubs, and plants of those portions of Europe with dry, hot summers, and cold winters. Boiken apple, Batullen apple, Bauman's Reinette, etc., Sapieganka pear, and very many other things we grow, are just what Kansas needs. So in the peach line."

Of all these sorts, scions or seeds were secured, and are now in process of trial on the grounds of the Iowa College; and their early dissemination among the intelligent horticulturists of the Northwest will soon show how valuable they are, and how fully the enthusiasm of Mr. Budd is warranted.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Mar. 20th to 31st.	April 1st to 10th.	April 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min.	38.	31.	38.	. .
Max	75.	71.	75.	. .
Min. and Max	56.	51.	56.	. .
Range	35.	40.	37.	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	45.4	38.3	46.4	43.4
2 p. m.	63.8	58.6	58.2	60.2
9 p. m.	52.8	41.0	48.1	47.3
Mean	54.0	45.9	51.5	50.3
RELATIVE HUMIDITY.				
7 a. m.	.89	.86	.94	.90
2 p. m.	.71	.68	.90	.76
9 p. m.	.87	.74	.86	.82
Mean	.83	.76	.90	.83
PRESSURE AS OBSERVED.				
7 a. m.	28.842	28.912	28.856	28.870
2 p. m.	28.794	28.982	28.839	28.872
9 p. m.	28.909	28.065	28.874	28.947
Mean	28.848	28.987	28.860	28.896
MILES PER HOUR OF WIND.				
7 a. m.	14.5	18.1	24.2	18.6
2 p. m.	18.0	20.3	33.5	23.9
9 p. m.	12.6	14.4	21.7	16.2
Total miles	4254	3740	5266	13260
CLOUDING BY TENTHS.				
7 a. m.	5.5	3.9	7.8	5.7
2 p. m.	5.1	6.5	8.2	6.6
9 p. m.	5.2	3.4	8.2	5.6
RAIN.				
Inches	1.35	0.07	2.99	4.41

The past month has been cool and moist to a degree that has retarded the preparation for planting and the starting of fruit-buds. Flowering currant-bushes and apple and cherry-trees were beginning to blossom in Topeka about April 20th. At this date little corn is planted. The severe storm from the 17th to 20th, in which considerable snow fell, put back the preparation of corn-ground about one week. The rain and snow of this storm was fully three inches, during as many days. No damage was done to fruit by the cold weather.

BOOK NOTICES.

CREATION: By Arnold Guyot, LL.D. 12mo., pp. 136. Charles Scribners' Sons, New York, 1884. For sale by M. H. Dickinson, $1.50.

Professor Guyot, who died on February 8th, after a long and useful life, principally spent as a teacher of Natural Science and for many years as Professor of Geology and Physical Geography in the College of New Jersey, united to his devotion to science the utmost reverence for the teachings of Scripture. His remarkable exposition of the true meaning and import of the first chapter of Genesis is the most satisfactory that has ever been presented by a man of science. The views here set forth have frequently formed the subject of public lectures by Professor Guyot, and have attracted much attention. It was among the last wishes of the distinguished author that his attempt to show the accordance of the sacred narrative with the facts of Geological science should be given to the world in its final and perfected form, and to the preparation of such a work he devoted his latest energies. It is entitled "Creation" and is an exposition of the Biblical cosmogony in the light of modern science.

This subject was presented by him as early as 1840 in Neuchatel, Switzerland, and has been repeated in lectures and essays from time to time, ever since. Prof. J. D. Dana has quite fully endorsed the views of Professor Guyot in all the editions of his "Manual of Geology" from 1863 to 1882, and they have met with the approval of Christian scientists and thinkers of all countries.

He divides the Creation into two acts, one relating only to cosmic or universal work and the other to the specific work done on this earth only. He also harmonises the two Mosaic accounts of the creation by separating them into two periods. The first period begins with the first chapter of Genesis and ends with the third verse of the second chapter, and is complete in itself, "forming an organic whole which unfolds the history of the Creation of the material universe and of living things, including Man as a part of Nature."

The second period begins at the fourth verse of the second chapter and takes up "under another aspect the creation of man as the head of the family of humanity and specifically of the Jewish people."

Professor Guyot offers the following tableau as showing the symmetrical arrangement of the parts and the special work of each cosmogonic day: I. The Prologue. *a*. The Primordial Creation of Matter, *b*. The Primitive State of Matter. II. The Era of Matter. The first Cosmogonic Day. First Activity of Matter—Cosmic Light. Second Cosmogonic Day, Organization of the Heavens. Third Cosmogonic Day, *a*. Formation of the Earth, *b*. the plants. III. The Era of Life. Fourth Cosmogonic Day, the Solar Light. Fifth Cosmogonic Day, Creation of Lower Animals in Water and Air. Sixth Cosmogonic Day, *a* Creation of Higher Animals on land, *b*. Creation of Man. Seventh Cosmogonic Day, Conclusion: the Sabbath. The work of each day is taken up regularly and discussed in the light of modern science, most ably and interestingly, with the foling conclusions, as stated tabularly at the close of the volume:

ERA OF MATTER.

Introduction.

THE BIBLE.	SCIENCE.
In the beginning God created the Heavens and the Earth. And the Earth was desolateness and emptiness; and darkness was upon the face of the deep.	Matter is not self-existent. Primitive state of matter. Gas indefinitely diffused.
First Day. And God said, Let Light be, and Light was. And God separated the light from the darkness.	*First Activity of Matter.* Gravity. Chemical Action. Concentration of diffused matter into one or more nebulæ, appearing as *luminous* spots in the *dark* space of Heaven.
Second Day. And God said, Let there be an expanse in the midst of the waters. And God made the expanse, and separated the waters under the expanse from the waters above the expanse.	*Division.* The primitive nebula is divided into smaller nebulous masses. Formation of the visible, lower, starry world.
Third Day. *a.* And God said, Let the water under the Heavens be gathered to one place and let the dry land appear.	*Concentration.* The nebulous masses concentrate into stars. Our sun becomes a nebulous star. Formation of the mineral mass of the earth by chemical combination of the solid crust, the ocean, and atmosphere. The earth self-luminous; a sun. First appearance of land. Azoic rocks.
b. And God said, Let the Earth bring forth vegetation.	First infusorial plants and protophytes.

ERA OF LIFE.

Fourth Day. And God said, let luminaries be in the expanse of the Heavens to separate the day from the night, and they shall be for signs, and for seasons, and for days, and for years.	Chemical actions subside. The earth loses its photosphere; sun and moon become visible. First *succession* of day and night, ef seasons and years. Differences of climate begin. Archæan rocks. Protphytes. Protozoans.
Fifth Day. And God created the great stretched out sea monsters and all living creatures that creep, which the waters breed abundantly, and every winged bird.	Plants and animals appear successively in the order of their rank—marine animals, fishes, reptiles, and birds. First great display of land plants. Coal beds. Paleozoic and mesozoic ages.
Sixth Day. *a.* And God made the beasts of the earth, and the cattle and every creeping thing of the ground after its kind.	Predominance of mammals; the highest animals. The beasts of the earth, Carnivorous; the cattle, Herbivorous animals. Tertiary age.
b. And God created man in his image.	Creation of man. Quaternary age.
Seventh Day.—Sabbath. And God saw all he had made, and behold it was *very good*. And God rested on the seventh day.	No material creation. Introduction of the moral world. Age of man.

History of the Discovery of the Circulation of the Blood: By Henry C. Chapman, M. D. Octavo, pp. 56. P. Blakiston, Son & Co., Philadelphia, 1884. For sale by M. H. Dickinson.

This essay was delivered as a lecture at the Jefferson Medical College, Dember 10, 1883, concluding a course on the circulation, and constitutes, with but little modification, a chapter in a forthcoming work on Physiology by the author. It sets out with the statement that the discovery of the circulation was not made by Harvey alone, but that due credit must be given to Erasistratus, Galen, Servetus, Cæsalpinus, Malpighi, Aselli, Pecquett, Rudbeck, and Bartholinus, whose investigations extend over a period of 2,000 years, from the epoch of the Egyptian Ptolemies to the latter part of the 17th century. Harvey was doubtless the first who correctly described the course of the blood in making the entire circuit of the body, although the function of the capillaries in transferring the blood from the arteries to the veins was not discovered until after his death. To Malpighi is the honor of this important discovery due.

The story of the discovery of the circulation of the blood is told hastily, but accurately and attractively, from the days of the Greeks, who knew that the blood flowed in the veins, but supposed that the arteries, from their being found empty in *post mortem* examination, carried only air. Even Aristotle could only teach that the veins communicated with the heart, that vessels passed from the heart to the lungs and that the heart and veins were filled with blood.

Galen, who learned his anatomy in Egypt, was the first to demonstrate that the arteries as well as the veins carried blood, which was of course the golden link in the chain leading to the discovery of the circulation. Servetus was the first to point out the aëration of the blood carried to the lungs by the pulmonary artery. Several pages are devoted to an account of his life and discoveries.

Harvey in 1628 not only the first to describe the entire circulation correctly but also to give the first accurate account of the movements of the heart and of its auricles and ventricles. To Malpighi, in 1661, science is indebted for the discovery of the capillaries connecting the veins and arteries, thus completing the discovery of the complete circulation of the blood.

The Elements of Political Economy: By Emile De Laveleye. 12mo., pp. 288. G. P. Putnam's Sons, New York. For sale by M. H. Dickinson, $1.50.

This work is designed by the author as a manual of instruction, and with that object in view he deviates from the usual course of writers upon the subject and comprises within his scheme, as correlatives, philosophy, moral science, the traditions of the past, history and geography. He says in explanation of this that "Geography describes the positions of Nations and History relates their annals. No advantage can be gained from the lessons which either offers without the aid of political economy. At the present day it is allowed that the most important part of history is that which traces the progress of humanity

in comfort and liberty. To understand this advance from prehistoric barbarism to the prodigious development of wealth which marks our own epoch, a knowledge of economy is indispensable." Carrying out this idea he quotes freely from recognized authorities, and with the enunciation of each principle of political economy he has given illustrative examples or maxims to enforce attention to it.

In speaking of the importance of a knowledge of this subject he says, "As citizens of a free country we need the training of men. From our earliest years the state claims our attention; even in childhood political economy ought to make us see that freedom leads nations to prosperity, while despotism leads them to decay. Need more be urged to prove the necessity of spreading economic knowledge?" He then points out that the greater part of the evils from which societies suffer spring from their ignorance of this subject. National rivalries, restrictions on trade, wars of tariffs, improvidence of the working classes, antagonism between workmen and employers, over-speculation, ill-directed charities, excessive and ill-assessed taxes, etc., all are indicated as so many causes of misery, springing from economic errors.

The treatise is the work of an able and experienced man, and while it may not in every particular apply directly to our national conditions, it will be found valuable, reliable and suggestive to all students of the general subject while the introduction and supplemental chapter by Prof. Taussig, of Harvard College, may be regarded as strictly applicable to our own country.

OTHER PUBLICATIONS RECEIVED.

The Sewerage of Kansas City, by Robt. Moore, C. E., with Discussion and Reply by O. Chanute, C. E., pp. 20. Notes on Glaciers in Alaska and Favorable Influence of Climate on Vegetation in Alaska, by Thomas Meehan, pp. 8. Notes on the Literature of Explosives, No. VI, by Prof. Chas E. Munroe, U. S. N. A., pp. 29. Quarterly Report of the Kansas State Board of Agriculture, March 31, 1884, Wm. Sims, Secretary, pp. 94. Speech of General Wm. H. Powell at the Banquet of the Press Association of Southern Illinois, upon "Our Industries." *St. Louis Druggist*, April 26, 1884, weekly, $2.00. Second Annual Report of the Health Department of Kansas City for the calendar year 1883, by Dr. John Fee, pp. 60. Mound-Builders Works near Newark, Ohio, by Isaac Smucker, pp. 20. *The Builder and Manufacturer*, Pittsburgh, Pa., monthly, $2.00 per annum. Report of the Professor of Agriculture, Kansas State Agricultural College. Experiments, 1883, by Prof. E. M. Shelton, pp. 48. *Random Notes*, Volume I, No. 3, Southwick & Jencks, Providence, R. I. Fifteenth Annual Report of the American Museum of Natural History, New York, March, 1884, pp. 36. Bulletin of the Philosophical Society of Washington, Vol. VI, for 1883, pp. 168. Methods of Historical Study, by Herbert B. Adams, Ph.D., Johns Hopkins University, pp. 136. Bulletin of the American Museum of Natural History, February, 1884, Vol. I, No. 5, pp. 40.

SCIENTIFIC MISCELLANY.

A MISSOURI RIVER COMMISSION.

Mr. Clardy's favorable report on the Graves bill to create a Missouri River Improvement Commission is one of very great importance, and is substantially as follows:

The object of the bill is to establish a Missouri River Commission, composed of two officers of the Engineer Corps, one of the Coast and Geodetic survey and two civilians, to superintend the expenditure of money appropriated by Congress for the improvement of the navigation of the Missouri River, and to make the necessary investigations and study of that river for the purpose of devising the most effective and economical method of using the annual appropriations made for this water-way.

To properly appreciate the importance of legislation, whose object is the keeping in repair this national highway, it may be well to consider that this river has a length of over 3,000 miles, and has been navigated its entire length from its mouth to Fort Benton, in Montana.

The States of Missouri, Kansas, Iowa, Nebraska, and the Territories of Montana and Dakota, are drained by its waters, while Colorado, Wyoming and New Mexico are to be considered as greatly interested in and affected by the commercial problems involved in the improvement of this river.

The census of 1880 shows that Kansas, Nebraska and Montana and such portions of Missouri, Iowa and Dakota as may be fairly embraced in the Missouri River Valley contain 260,000,000 acres, 3,500,000 people, whose assessed wealth aggregates $1,250,000,000, of which $900,000,000 consist of landed property and the remainder is principally live stock, there being near 5,000,000 head of cattle, 1,500,000 horses, 4,700,000 hogs and over 2,000,000 head of sheep. It produced in 1879 over 60,000,000 bushels of wheat, over 400,000,000 bushels of corn, 53,000,000 bushels of oats, 1,800,000 bushels of rye, and 4,300,000 bushels of barley. During 1881, the Government collected in this district internal revenue alone amounting to $7,727,000. Could the census be shown for the year 1883 the foregoing estimates would be surprisingly magnified.

That this great water-way should be put in the best navigable condition is in accordance with the rules of political economy as well as common sense, it being located in a region so fertile and productive of all that administers to the wants of teeming millions. It is located where it is most needed and where it can perform the greatest service in the shape of transportation. With the great natural advantages possessed by this water-way it should be the main dependence for the bulky freights of an agricultural valley. But it is the channel of commerce least

in use. At first the railroads were considered merely tributary to the water lines; but now the railroads have gained in prestige until the river has lost its commerce and has become merely tributary to the railroads.

The people of this valley are beginning to appreciate the fact that it is a costly luxury to ignore the plans of nature, and now, more than ever before, they are considering the international features of this great river.

The language of the Supreme Court of the United States in the case of Daniel Ball, 10 Wallace, 557, fitly applies to this river. The court said: "Those rivers must be regarded as public, navigable rivers in law which are navigable in fact. And they are navigable in fact when they are susceptible of being used in their ordinary condition as highways for commerce over which trade and travel are or may be conducted in the customary modes of trade and travel on water. And they constitute navigable waters of the United States, within the meaning of the acts of Congress, in contradistinction to the navigable waters of the States, when they form in their ordinary condition, by themselves or by uniting with other waters, a continued highway over which commerce is or may be carried on with other States or foreign countries in the customary modes in which such commerce is conducted by water.

This is the legal aspect in which such rivers as the Missouri are viewed by our highest supreme judiciary.

The case is well presented in its scientific and economic aspect in the following extracts taken from the letter of the Secretary of War of February 17, 1881, "in relation to the improvement of the Missouri River," transmitting to the House of Representatives a report from Major Suter of the Engineer Corps, upon the improvement of this river, as follows:

"The importance of the subject can hardly be overestimated, as this river is the longest of any in the United States, and is with the exception of the Ohio, the largest tributary of the Mississippi. Its channel length from its sources in the Rocky Mountains to its junction with the Mississippi near St. Louis, is probably something over 3,000 miles, and it brings forward the drainage of an area of 572,672 square miles. It is navigable for nearly its whole length, for the portion above the Great Falls, near Fort Benton, is already provided with several small steamers. Its tributaries, though often of great length, are not of great size, and are rarely navigable in their present condition.

The country through which the Missouri flows is mostly one of a small rainfall, so that its really large discharge is due to the great area of its drainage basin and the mountain snows and ice near its headwaters. Its most salient and striking features are the remarkable impetuosity of its current, and its slope, which is considerable for so large a stream. The rapidity of the current and the general instability of its banks and bed give rise to the excessive turbidity of its waters, which have earned for it the title of the "Big Muddy." It is, in fact, the great silt-carrier of the country, and the enormous mass of sediment which it brings forward forms the great bulk of that received by the Mississippi from its tributaries. Its influence upon the main river is most marked; indeed it is its proto-

type in its main physical features, and, from the navigation point of view, at least, it may be said to have a marked controlling effect upon the main trunk stream. The subject of its improvements, therefore, is not only of local interest, but is of the greatest general importance, now that the improvement of the Mississippi is receiving serious consideration."

"And upon page ten of said Report the following is found: "Work already done furnishes me the means of approximately estimating the cost of this improvement, which, if carried out on a large scale, and with liberal appropriations, will not probably exceed $10,000 per mile. This would put one cost for the whole 800 miles under consideration at $8,000,000, and from Kansas City to the mouth of the river at $3,750,000. See ex. document No. 92, third session, Forty-sixth congress.

The single state of New York has expended over $80,000,000 in the construction and improvement of 1,300 miles of canal within her borders. Whereas, by this report to the War Department the internal revenue collected for a single year from the district directly interested in the improvement of this river would defray the expenditure in making this national highway permanently navigable throughout its entire length, and one-half that amount would do the work from Kansas City to its mouth.

This report concludes with the following language:—

"The benefits attendant on such an improvement can hardly be over-estimated. With a guarantee that at lowest navigable stages a safe and permanent channel, having nowhere a less depth than twelve feet, will be available, boats and barges as large as any now used on the Lower Mississippi could be built and safely navigated. They could also be provided with heavy power and staunch hulls, such as would be needed to cope with the strong current of the Missouri River. Snags, which now are great and ever-present obstructions, would be to a great extent swept away by the deep scour of floods, and the supply of new ones would be materially reduced by the general prevention of bank erosion. The amount of sediment carried into the Missouri would be proportionately reduced by the same work, and very substantial benefit be thus directly received by that river. The whole valley of the Missouri is extremely fertile, and if reclaimed, as it would be by this improvement, would soon be all under cultivation, and the amount of grain which would seek the river transportation would be enormous. The estimate for the whole work thus sketched out is $8,000,000, which could, with due regard to economy, be expended at the rate of $1,000,000 per annum. At this rate the whole improvement would require eight years for completion, or from Kansas City to the mouth four years, with proportionate increase of time if the annual appropriations should be smaller than here indicated."

For the ensuing fiscal year the Secretary of War submits the following estimate to be appropriated:—

For the improvement of the navigation of the Missouri River, $1,400,000;

for snagging the same, $188,000; for continuing survey on same, $50,000; and for the improvement of the Yellowstone tributary, $100,000.

The magnitude of the interests involved, and the peculiar characteristics of the river, differing as it does from any other in the United States, in the judgment of your committee render the appointment of a Missouri River commission, as contemplated in the bill, a necessity, and we, therefore, report the same with a recommendation that it do pass.

We further recommend that the same be so amended as to have three members of the army corps of engineers and two civilians compose said commission, instead of two members of the army corps of engineers and one of the coast and geodetic survey and two civilians, as provided by the bill.—*Kansas City Times.*

PROPOSED NEW ROUTE TO EUROPE.

King Leopold, of the Belgians, it is reported, is engaged in an enterprise having for its object the founding of a new route for ocean travel between America and the old world. The route selected will, it is said, be direct from New York to about the 40th parallel, and along that to the Portugese coast, with the European entry at Lisbon or Cadiz. The Portugese and Spanish Governments have both been sounded upon the subject, and will, it is understood, do all in their power to improve direct railway communication from the selected port to Paris, and to improve the harbor facilities at the designated port of entry. The navigators and engineers who have given the subject special consideration approve the project thoroughly and pronounce the new route the best possible between America and Europe. The 40th parallel is comparatively free from the long storms besetting the present ocean courses, and icebergs rarely get so far south. From New York to Liverpool steamers must average a change of nearly 14° latitude from south to north, and, with the exception of about five months out of the twelve, have to contend against weather and seas practically Arctic in fitfulness and dangers. This confines first-class travel to the summer months and adds enormously to the cost of shipping and insurance in the winter months. The Belgian engineers pronounce the port of Liverpool the most unnatural and difficult of approach of all the great ports of the world, and declare it to be their belief that because of this, and of the long journey from Queenstown to the Mersey, Liverpool must soon cease to occupy its present importance as the principal port of European entry. The solution of the ocean problem, these engineers declare, will be only found in a route with an Atlantic port at the eastern terminus, which must be as nearly as possible on a line straight east from New York, and in Portugal or Spain.

The principal advantages of the 40th parallel route are claimed to be the following: First, a clear ocean passage below the line of icebergs and winter storms, from port to port, enabling steamers to run with full power the whole course: second, comparatively equable weather the whole year through, enabling

steamers to keep up the average and regularity of their trips in winter as well as in summer, and thus increase the number of round trips per annum from the present average of twenty to thirty; third, a temperate parallel, which will render passenger travel comparatively safe and pleasant the year round, and enormously increase it; fourth, entire avoidance of the dangers from icebergs and rough seas of the northern parallels, and a consequent prolongation of the life of ships and decrease in the costs of insurance. Besides the above advantages the new route, the Belgians claim, will be from 150 to 300 miles shorter than the route to Liverpool, and will have the Canary Islands as a sort of half-way station if necessary.

THE GREELY RELIEF EXPEDITION.

The advance vessel of the Greely Relief Expedition, the Bear, has sailed from New York for the polar regions. The other two vessels, the Alert and the Thetis, will quickly follow. These are the strongest and best equipped steamers that ever set out to battle with the ice. The prayers of millions of people in both continents will follow them on their mission of mercy. If Lieut. Greely and his party are still at Lady Franklin bay the relief vessels are expected to go there and bring them home; if they have started southward in the hope of reaching one of the supply depots which they established on their northern voyage on the coast of Grinnell Land and at Littleton Island, the relief party must search for them. Lieut. Greely's instructions were to abandon his station not later than September 1, 1883, should no relief ship reach him. If these instructions have been carried out there is no telling at what port the party may be waiting to be rescued. The relief ships are expected either to find them or to ascertain their fate.

The twenty-nine men who composed the Greely party are officers and enlisted men of the regular army detailed for duty in the signal corps. They were sent to Lady Franklin bay to establish and maintain a meteorological station for two years, in accordance with a plan agreed upon by the International Polar Commission. Nothing has been heard of Lieut. Greely since the day the Proteus left Lady Franklin Bay, in the summer of 1880. Two relief expeditions have been sent after the Greely party without avail, as the world knows. It is sincerely to be hoped that the third and last one may be successful.—*National Republican.*

"TAKING AIM"—TWO EYES OR ONE?

Quite a lively discussion is said to be taking place in England as to whether a marksman generally takes aim with both eyes or one in rifle shooting. Those who consider that one eye alone is used endeavor to prove their case thus:

Hold, they say, a ruler before the right eye in such a position that when the left eye is closed it covers the object; now shut the right eye, and see in which direction the ruler points; it will be found to be many inches, or feet, or yards away to the right, according to the distance of the object. It is therefore obvious, so the argument runs, that a man fixes the object, bird, or target, as the case may be, with his right eye, and neglects the image formed on his left retina altogether. The difference of opinion upon the subject depends, according to the *Lancet*, on the different practice of aiming adopted by different sportsmen. If a man shoots slowly, accommodates his eye to the sight or sights on the barrel of his gun, and then relaxes his accommodation for the distant object, and still more if he alternately exerts and relaxes his accommodation, for which there is ample time in target or any other deliberate shooting, then undoubtedly he uses one eye, and, of course, usually the right eye, alone. But the act of accommodation is a slow process, it requires nearly, if not quite, a second, and in ordinary bird-fowling the sportsman has no time for this. The more practiced he is the less he attends to his barrel and his sights. He first fixes the object with both eyes, and then points the barrel at the precise elevation and in the direction which long experience has taught him will be effective when the gun is discharged. He adapts his eyes for the distant object, and the rest is mechanical. Corroborative evidence that this view is correct is afforded by the fact that the bowler at cricket never closes one eye or troubles himself about any line. He simply fixes the wicket or the precise spot in front of the wicket on which he desires to pitch the ball, and leaves the rest to the co-ordinating nervous centers. The billiard player, again, in the vast majority of cases uses both eyes, and fixes alternately the near and the distant ball with both eyes. Therefore, if a man uses his sights and attends to his barrel as well as to the object, he employs one eye only, neglecting the impressions derived from the other. If, however, as is customary with experienced sportsmen, he takes no thought of his gun and fixes the distant object, then, undoubtedly, unless he has some defect of vision, he uses both his eye, the visual lines of which at thirty yards are almost parallel to each other.—*Scientific American.*

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

LIFE GUARD FOR FREIGHT CARS.—This invention consists of a platform, or plank, of suitable width and of a length somewhat shorter than the width of the freight car-end to which it is applied, and its object is to prevent the falling of the train-men from and between the cars to the track below, and the loss of life that unerringly attends such casualties.

The platform is secured at any desired height to the end of a car, through the medium of two or more supporting brackets upon and to which the platform is loosely connected by metal sliding-bearings.

These sliding-bearings are bolted to the underside of the platform and are forcibly kept at the outer extremity of the supporting-brackets by means of springs coiled thereon. Now, should two cars that are fitted with the platform, be brought together suddenly, as for instance, in a slight collision: the front edges of the safety platforms come in contact first, then, as the movement continues the springs are compressed until the limit is reached by contact of the dead-wood blocks on each car.

Should the cars be of different heights, the platforms will readily pass each other without compressing the springs, and the apparatus adapts itself easily to all the different movements of the cars, for even when the draw-bars are fully distended there is not sufficient space between the two platforms to permit the passage of a falling brakeman to wheels below.

No matter how slippery the car-top, or how dark the night, if a brake-wheel is wrenched off by a brakeman he cannot fall under the wheels, the Life-Guards will prevent it; and although he may slide off the platforms to the side of the track, his injuries will be comparatively slight. The inventor is Mr. Benjamin L. Ferris, of this city.

MANUFACTURE OF CORRUGATED METAL-SHEETS AND SECURING THE SAME, WITHOUT NAILS, TO BUILDINGS.—Hook-shaped fastenings are used instead of nails and stamped depressions along the edge of the sheets are adapted to fit snugly over the fastening-hooks that are previously attached to the timbers of a building.

The hooks for the ends of the sheets are simply pieces of wrought-iron that are, say, three inches in length, one-half inch in width and an eighth of an inch in thickness, having one end bent to form a smaller hook and the opposite extremity provided with openings for attaching them to the timbers by means of wood-screws.

The sheets of metal are prepared by running them through a corrugating machine; this machine has suitable dies upon the rollers which form the depressions along the corrugated edge of the sheet as it travels between them. In applying the roofing to a building, a sufficient number of the straight-hooks are attached to the timbers at such a distance apart as will correspond to every other longitudinal depression in a previously laid sheet, then an over-lapping sheet having the before mentioned indentations along its lower edge, is placed in such a position that the indentures fit within the short hooked-ends of the fastenings. As before stated, the indentations are to make room for the fasteners so that the overlapping sheets will not be held away from the one previously laid, and their overlapping straight edges are secured by means of substantially the same form of fastenings as are used for the corrugated edges, the only difference being that the body of the straight-edged fasteners are curved to fit the concavities of the sheet.

These fastenings for the straight-edges are placed at suitable distances apart and in applying them a line of sheets having been run up the building, the

fasteners for the straight-edges are placed so that their curved ends fit across the outside convex edge of the sheets, and upon applying another course of roofing the contiguous edges lap over, and are held in position by the short hooks upon the curved end of the side-fastenings.

This method of applying corrugated roofing, etc., dispenses entirely with leaky nail-holes and nails, and in addition to other advantages over the old rigid nailing process, the sheets are free to expand or contract with the varying temperatures in which they may be placed. Recently patented by Mr. John Smith, of this city.

EDITORIAL NOTES.

MAJOR F. F. HILDER, of St. Louis, having been appointed by the Governor of this State commissioner to the "World's Industrial and Cotton Centennial Exposition," which will be opened at New Orleans the first Monday in December, 1884, calls attention to the importance of having the vast resources of Missouri in minerals, soils, manufactures, and agricultural products fully represented. The State having made no appropriation for the purpose, he appeals to its patriotic citizens to contribute funds to cover the necessary expenses.

THE Social Science Club of Kansas and Western Missouri meets in this city Thursday and Friday, May 8th and 9th, at the Second Presbyterian Church. It is made up of the best educated and most thoughtful ladies of this region, and the papers to be read at its sessions will be of engrossing interest.

To give an idea of the amount of passenger business done at the Union Depot in this city, we select a few items from the report of the Treasurer of the Union Depot Company for six years, ending December 31, 1883: Cash received for tickets in 1878, $474,591.26; for 1883, $1,161,202.26, an increase in six years of $786,611.30. The total cash receipts for the whole time were $5,763,572.47, to which is to be added the value of tickets exchanged, $413,061.63, making a grand total of $6,176,634.10.

JANSEN, McCLURG & Co. have published a series of very useful Tables for the Determination, Description, and Classification of Minerals, by James C. Foye, A. M., Ph. D., Professor in Lawrence University. Second edition, revised and enlarged. Mineral species are determined by tables I. and II; table III gives the crystalline structure, fracture, specific gravity, hardness, luster, streak, color, action of acids, and blowpipe reactions of each species; table IV classifies the species according to the 5th Ed. of Dana's System of Mineralogy; table V classifies by basic elements and ores. The Appendix enables one to distinguish between some of the closely allied species and varieties. Scales of hardness and fusibility, systems of crystallization and all the blowpipe reactions referred to in the work are fully described in the introduction. Cloth, 12mo., 85 pages; price $1.00. It is a very complete work and offered at a very low price.

ON Monday, the 21st ult., snow fell in this city continuously for twelve hours, viz.: from 6 A. M. to 6 P. M., amounting to at least six inches, though as it melted nearly as fast as it fell it could not be measured. We put this on record as a phenomenal day.

THE U. S. Signal Office has published four maps presenting the specific meteorological features of the tornadoes of March 11th, 1884, and showing the general relation between areas of barometric minima and tornado centres. This advance work is to be followed by a full report of a more extended investigation.

MRS. J. LAWRENCE SMITH, of Louisville, Ky., the widow of the late Professor J. Lawrence Smith, has donated $8,000 to the National Academy of Science, the income from which is to be used for the encouragement of scientific investigation.

PROF. JEAN BAPTISTE DUMAS died at Paris on April 10, at the age of eighty-four. He was born in Alais, July 14, 1800. Under the patronage of De Candolle, at Geneva, he early acquired considerable proficiency as a botanist and chemist. In 1821 he went to Paris, married the daughter of Alexander Brongriart, and was professor of chemistry in the polytechnic school, in the faculty of science, and in the school of medicine. In 1868 he was elected perpetual secretary of the academy, and in 1869 the London Society of Chemistry gave him the Faraday medal. He was the author of many standard scientific works.

THE results of a recent investigation by the British Medical Association gives color to the theory that consumption is an infectious disease. Circulars were sent out to over 1,000 physicians, asking for experiences and opinions in that connection, and of the number who replied a decided majority expressed a belief in the affirmative.

THE Canadian weather-prophet, Wiggins, claims that the recent storms and earthquakes in England were a fair fulfillment of his March predictions. The Professor believes that there is serious probability that the earthquake in England will return with increased violence about the 20th of this month.

ON Tuesday, September 2d, 1884, the grand International Electrical Exhibition will open at Philadelphia, under the auspices of the Franklin Institute for the promotion of the mechanical arts, and continue until October 11th, 1884. For information apply to Prof. Wm. H. Wahl, Secretary.

THE Washington monument reached the height of 410 feet on the 22d ult. The total height of the shaft will be 555 feet, which will make it the highest monument in the world. This leaves 145 feet yet to be added, fifty-five of which will be a marble roof of pyramidal shape.

A great well of natural gas was struck at Wellsburg, West Virginia, twelve miles north of Wheeling, on the 24th of April, at a depth of 1,287 feet.

DURING the week from June 28 to July 5, inclusive, it is proposed to institute a summer school of geology at the Delaware Water Gap, Monroe Co., Pa.—a locality peculiarly suited for geological instruction, under management of Prof. H. Carvill Lewis. Excursions to various points of geological interest will be taken every day, and opportunity given for studying in detail the various formations in place of their influence upon the topography. Each evening an illustrated lecture will be given upon the geology of the region.

ONE of the best American science magazines that comes to our table is the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY. It comprises original articles by the best writers, and selections from the best periodicals of this country and Europe on all scientific subjects, and is deserving of the patronage of all intelligent and enterprising educators East and West.—*Boston Journal of Education.*

THE Normal School *Advocate* says of the REVIEW, "Every teacher should be a subscriber to this truly excellent periodical."

WE are indebted to the editor, Theo. S. Case, for a copy of his sterling periodical, which is a credit to the scientific taste and culture of the West. It fills an unfilled corner of the periodical literature of the West and should have a place upon the table of every lover of science.—*Council Grove Republican.*

THE main building of the World's Industrial and Cotton Centennial Exposition, at New Orleans, now being constructed, is in many respects the most remarkable edifice ever erected in this country. It is 1,378 feet long by 905 feet wide, covering thirty-three acres, or eleven acres more than the main building of the Philadelphia Centennial Exposition of 1876. There are 1,656,300 square feet of floor space, including the gallery.

The building will be sixty feet high with a tower 115 feet high, and the architect has been unusually fortunate in rendering the exterion exceedingly unique and attractive. To light it with incandescent lamps will require 15,000 lights and 1,800 horse-power. To light with the arc system will require 700 lamps and 700 horse-power to operate the dynamo. The total steam required for lighting and for machinery hall will be at least 3,000 horse-power. In this estimate is included the power for five arc lights of 36,000 candle-power each, which will light the grounds.

THE Edinburgh University celebrated its 300th anniversary last month. Scotland, England and the world owe very much of the best thought of the last three hundred years to this institution, and some of the strongest men of the age, have issued from this old and honored seat of learning. Mr. Lowell had a worthy part in the celebration, and was introduced by Sir Stafford Northcote as "one of the greatest literary ornaments" of our own time.

IT is now officially announced that the tunnel under the Mersey, which is to connect the cities of Birkenhead and Liverpool, will be formally opened for ordinary traffic on the 14th of next month. The last remnants of the wall between the two ends of the tunnel were blown out on the 26th of April.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

THE best articles in the May *Popular Science Monthly* are: The Beaver and His Works, by Dr. G. A. Stockwell (Illustrated); The Progress of the Working-Classes in the Last Half-Century, by Robert Giffen, LL. D.; The Milk in the Cocoa-nut, by Grant Allen; Longevity of Astronomers, by Albert B. M. Lancaster; How Flies Hang On, by Dr. J. E. Rombouts (Illustrated); Where Did Life Begin? by G. Hilton Scribner; Christian Agnosticism, by the Rev. Canon Curteis; The Beginnings of Metallurgy, by Dr. E. Reyer; The Mortality of Happiness, by Thomas Foster; Sketch of Mary Somerville, (with portrait), followed by the usual Correspondence, Editor's Table, Literary Notices, Popular Miscellany, and Notes.

Immigration continues to be one of the great economic questions of this country, and it involves a political problem of the highest importance, that of naturalization. Our naturalization laws are defective in many respects, and the demand for their revision will no doubt acquire added force from the publication of an article by Justice William Strong upon that subject in the *North American Review* for May. In the same number of the *Review*, Edwin P. Whipple offers a candid judgment of Matthew Arnold, as a thinker and as a man of letters. Richard A. Proctor, under the title of "A Zone

of Worlds," writes of the vast multitude of the pigmy kindred of the earth, known as the asteroids. In "The Railway and the State," Gerrit L. Lansing essays to prove that the multiplication and extension of railroad lines, and the establishment of low rates of transportation, are hindered, rather than helped by governmental interference. Prof. Henry F. Osborn, of Princeton College, has a highly interesting article on "Illusions of Memory." Helen Hendrick Johnson contributes an essay on "The meaning of Song." Finally, there is a joint discussion of "Workingmen's Grievances," by William Godwin Moody and Prof. J. Laurence Laughlin, of Harvard University.

WE have had occasion before to refer to the *Western Art of America*, a musical periodical edited by Mr. Emil Seifert. It has now reached its fourth month and secured a firm footing among the periodicals of the city. To those of our readers who do not see it we can recommend it as a reliable and critical compendium of passing events in musical and art matters, edited by a competent critic and skillful musician. We know of no similar paper in the West and it should be well supported.

THE Scientific Basis of Morals, and other essays, by William Kingdom Clifford, F. R. S.; price 15 cents, post free. J. Fitzgerald, publisher, 20 Lafayette Place, New York. This collection of essays upon Ethics forms No. 55 of the *Humboldt Library of Popular Science*. Besides the essay named in the title, it contains three others, namely, "Right and Wrong: the Scientific Ground of their Distinction;" "The Ethics of Belief;" and "The Ethics of Religion."

Harper's Magazine for May concludes th sixty-eighth volume of that now venerabl but never aged periodical. The cosmopol tan character of our American magazin has never been better illustrated than in th announcements of this number. Certainl American topics, authors, and artists a thoroughly represented, but there are als papers on English, French, and German sul jects, written by Englishmen, Frenchme and Germans, and illustrated by Englis and French artists. William Black, Wil iam Sharp, Alfred Parsons, A. F. Jacass and Dr. Moritz Busch are among the co tributors in question. Yet *Harper's* is com monly accounted the most American of ou magazines.

IN the *Atlantic Monthly* for May Richar Grant White contributes the first of two a ticles entitled "The Anatomizing of Willia Shakespeare," a very acute and interestin study of the facts of Shakespeare's life an writings, dissipating some of the idolatrou illusions which some extreme Shakespear worshipers have created. Henry Jam continues his French studies of trave Prof. E. P. Evans has an article on "Lir guistic Palæontology" which will be foun of deep interest to all intelligent reader Articles of public national interest are "The Silver Danger," by J. Lawrenc Loughlin; and "The Progress of Nationa ism," by Edward Stanwood. The poems the number are by T. B. Aldrich, H. H., an Edith M. Thomas. Several important book are reviewed, and the Contributors' Clu completes a thoroughly interesting and a tractive number of this sterling magazin Houghton, Mifflin & Co., Boston. Subscrip tion $4.00.

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GEOLOGY.

THE RUSSELL ARTESIAN WELL.

JOHN D. PARKER, U. S. A., FORT HAYS, KANSAS.

Recently I made a visit to Russell, Kansas, and was very much interested in an artesian well which the citizens of that enterprising town have been boring. The town voted ten thousand dollars worth of bonds, and engaged a company from Milwaukee, Wisconsin, to make the boring which has not been put down as far as they contemplated at the beginning. As the drill did not take out a core, the boring at certain intervals was stopped, by pressure on the sides, and a smaller bore within the larger adopted, the whole bore appearing like an inverted jointed telescope, with the exception that the tubing of each bore comes to the surface of the ground. Each time a smaller bore was commenced within the larger bore there was some delay in obtaining the cast-iron tubing, which was manufactured at Pittsburg, Pennsylvania, and the company at last, at the time of one of those delays, abandoned the work.

It is impossible to say what may be the final adjustment of the matter, but it is hoped that the well will be completed with a diamond drill which takes out a central core, until if water is not sooner found, the depth of 3,500 feet has been reached, which was first contemplated. I deem this a matter of the highest importance, as a test of artesian wells in Western Kansas. If artesian wells can be obtained in Western Kansas, it will change the face of the whole country.

The soil is very rich and productive, and a good supply of water would make it one of the finest stock countries in the world. Fine forests would spring up in all parts, and the cereals and grasses would become more certain and abundant.

In Western Texas, the wonderful springs and the dip of the strata led to the boring of artesian wells. It was noticed that the springs were fed from a great distance, probably from the mountains, as they were not affected by the local rainfall. The Texas Pacific Railroad was rewarded in finding an abundance of the finest water in the artesian wells which they bored at Toyah, Texas, and at other places. The same results would probably follow in Western Kansas, and therefore, it is hoped that the people at Russell may thoroughly test this matter, which has such a vital interest to the welfare of the people living in this portion of the State.

Mr. F. C. Jerome, of Russell, has very kindly furnished me the following statement regarding this artesian well:

PROF. JOHN D. PARKER.

DEAR SIR.—Inclosed please find a report of the artesian well at this place, together with an analysis and classification of the rocks and shales, which you requested me to write for the KANSAS CITY REVIEW OF SCIENCE.

The most important question in Western Kansas is that of irrigation. This want does not arise from the fact that this portion of the State is barren, or that the general rain-fall is not sufficient. There are times, at least every few years, when drouths, more or less local, visit this section, entailing thereby many failures of certain crops, and it is from these visitations that has arisen the question of irrigation—how to provide for wheat and corn and other products when the rain-fall shall prove insufficient. As yet, Western Kansas is a very new field for agricultural pursuits, but very far from being unprofitable or experimental. In coming years it will be one of the grandest countries for farm products of every description, that the nation has ever seen, but now, being in its infancy, it must learn to creep before it can walk. The vast chalk beds must be decomposed and allowed to give out the immense quantity of lime and carbonic gas they contain, the crude gypsum must be made to unite with the soil by cultivation, and this cultivation to be successful must have an abundance of moisture to assist it in properly preparing the ground. The charactistic drouths that occasionally visit this section are mainly due to the newness of the country and the chemical changes going on with the minerals in the ground.

It was to solve this question definitely that the enterprising citizens of Russell voted bonds to the amount of $10,000 to sink an artesian well at this place, and although the work is not yet completed, the developements give us some very interesting facts to consider, and tell us something about this part of the State that could not be known in any other manner.

The following are the deposits encountered in the well up to the present writing, together with their composition and position. I have given the rocks the most careful examination, and they are exactly as reported:

CRETACEOUS PERIOD.	FEET.	INCHES.	TOTAL CRETACEOUS PERIOD.
BENTON GROUP.			
Upper Soil	10		
Yellow Clay, containing thin Magnesian Limestone . . .	25		
Gravel and Fresh Water.			
Dark Blue Variegated Shale	70		
Trace of Coal.			
Dark Blue Variegated Shale impregnated with Talc . . .	34		
Gray Sandrock impregnated with iron pyrites	15		
Vein of Fresh Water.			
Gray Friable Sand-rock	10		
Light Blue Soapstone	32		
Dark Blue Soapstone, containing coal	3		
Light Blue Soapstone	12		
Depth of Benton Group	211		211
DAKOTA GROUP.			
Light Blue Argillaceous Sand-rock	10		
Strong Vein of Salt Water.			
Blue, turning to pink, then red, Soapstone	17		
Red Sand-rock	2		
Vein of Hot Water.			
Red Sand-rock with Nodules of Ferruginous Limestone . .	60		
Light Blue Shale	15		
Light Gray Sand-rock with Iron Nodules	30		
Total Depth of Dakota Group	134		134
			345
UPPER CARBONIFEROUS			
Gray Quartzose Rock	50		
Light Blue Pyritiferous Friable Sand-rock		.01	
Gray Quartzose Rock	5		
Brown Sand	9		
Brown Ferruginous Quartzite, containing gold, silver, copper and iron ore comglomerate	26		
Vein of Salt Water.			
Light Blue Shale	48		
Trace of Gypsum.			
Light Blue Shale	182		
Brick-red Calcareous Clay (Pottery Clay)	74		
Blood-red Marl (Fertilizer)	60		
Brick-red Calcareous Clay (Pottery Clay)	56		
Impure Gray Limestone, with Hornstone	35		
Dark Red Variegated Gypsiferous Shale	20		
Small Vein of Coal.			
Dark Red Variegated Gypsiferous Shale	67		
Coal.			
Total Upper Carboniferous	632	.01	

TOTAL DEPTH OF WELL.

Cretaceous	345.
Upper Carboniferous	632.01
Total No. of feet	977.01

RISE AND FALL OF WATER.

Amount of Water in Well at certain depths.		Distance from Water to top of the Well.	REMARKS.
Depth of Well.	Feet of Water.		
154 feet.	30	144 feet.	Cold.
159 "	60	109 "	Cold.
160 "	80	80 "	Cold.
240 "	100	140 "	Boiling hot.
260 "	156	104 "	Warm.
290 "	170	120 "	Lukewarm.
308 "	190	118 "	Cold.
380 "	180	200 "	Cold.
388 "	223	165 "	Cold.
395 "	230	165 "	Cold.
400 "	250	150 "	Cold.
435 "	259	176 "	Cold.
500 "	350	150 "	Cold.
880 "	700	180 "	Cold.
977 "	742	235 "	Lukewarm.

The rise in the temperature of the water first noticed at 100 feet.

The measurements and analysis of the rocks, etc. in the above tables are accurate, having taken the measurements myself as the work continued on the well. The only difference in opinion seems to arise in the geological distribution, in which Prof. O. St. John takes friendly exceptions with me. In a former report I classed the Benton group down to the Red Sandstone of the Dakota. Prof. St. John is under the impression that the Benton ends just above the fifteen foot stratum of gray sand-rock impregnated with iron pyrites.

In Western Kansas, and very prominent in Russell county, on Salt creek, four miles north of Russell, and in many places along the Saline river, the horizon rock of the Dakota group is a light blue argillaceous friable sand-rock. This appears to be a permanent feature so far as I have had leisure to examine them. The artesian well here is on the uniform high prairie, and I have found no indications of faults, or of intrusive rocks, and hence I am of the honest conviction that this light blue argillaceous friable sand-rock stratum is the true horizon rock of the Dakota, which I refer to above, and I have changed the report in this respect, believing this to be correct, and should any other errors appear, I will be glad to correct any and all, only desiring to learn the true facts.

My reasons for classing the quartzose rock with the upper carboniferous are, from what examination I have given this rock, it *appears* to be of a granulated structure, or metamorphic, though I am far from being satisfied, having

had but a very small specimen for examination. The pottery clay and marl referred to, are valuable deposits, and the clay, especially, is very pure.

The hot water referred to was sufficient to boil an egg in three minutes. The heat I am under the impression was caused by the iron pyrites by some chemical changes, not caused by the well, but which have continued probably for ages. I did not procure any of the hot water for analysis.

The yellow clay, underlying the upper soil, I have been fortunate in examining its structure for five feet ten inches, the remaining twenty feet I have not yet had opportunity to examine.

The following is the yellow clay at the Benton so far as I have had an opportunity to examine it:

Clay colored with Iron of aqueous formation and laminated, and of friable nature.	3 feet.
Lime, Magnesium and chalk, (natural lime) containing fossil fish scales, *Inoceramus*, and *Ammonites*, *with iron nodules*	1 foot.
Ferruginous limestone, containing fossils of *Inoceramus*, fish scales and *ctenoides gigantea* and sharks' teeth	0.10 inches
Silicious ferruginous limestone, (no fossils)	1 foot.
Total	5.10.

The work on the well has not yet been completed, and of course the matter of irrigation has not yet been settled, though I am pleased to say from present prospects the well will be completed successfully under government aid, and the question of artesian water will be settled. In this respect I am under the impression that a good vein will be tapped somewhere about 2,000 feet, as there is every indication to show that a very large vein underlies this locality, but this remains for future investigations to bring forward. Respectfully,

F. E. JEROME.

RUSSELL, KANSAS, April 26, 1884.

The anomaly in this boring is the finding of boiling hot water at the depth of two hundred and forty feet. This water must have derived its heat from local causes, as the increase of heat after passing the stratum of invariable temperature, is only one degree Fahrenheit for every fifty or sixty feet of descent.

MINES OF CARTERVILLE, JASPER CO., MISSOURI.

PROF. G. C. BROADHEAD.

The general surface is rolling with hills rising about eighty feet above the creeks. The creeks have narrow valleys rising by gentle ascent to the adjacent hills; which are sometimes modified by terraces.

The mining is confined to the valleys not far from the railroad, and are more productive from 100 to 125 feet below the surface. The ores are chiefly zinc.

From careful examinations we find as follows: The highest rocks seen near by are of a porous or bony looking chert. This occurs in broken and chiefly angular masses on the hill-tops. On the tops of the hills I also observed water-worn chert in considerable quantity and apparently of same age as the massive chert. Outcrops on the hill-sides and revelations in the shafts prove the existence of a limestone about five feet below the hill-tops. Fossils were obtained both from the chert and limestone, but only a few species. Among them I recognized *Spirifer Keokuk*, *Sp. lateralis*, *Hemipronites crenistria*, *A. Rhynchonella*, *A. Phillipsia*, *Bujozoa* and *Crinoid* stems. Sufficient to be identified with the Keokuk group of the Lower Carboniferous.

Shallow shafts in draws and valleys show quite an extensive deposit of a blue clay shale. The shale is thickly laminated, and may be of the same geological age as the limestones, but I could obtain no fossils from it. The fact of its being reached in the valleys, also in some shafts on the hillside (where it is found above the limestone) also occupying pockets or "bars" as the miner would say, would indicate that it was newer than the limestone. It really may have been deposited from a flow through cavities in the other older rocks, in caverns. Another fact, although found in the mines it is not ore-bearing, but generally contains a good deal of iron pyrites.

A general section of the rocks here, both concealed and exposed, is about this,—

1. Fifty feet of porous or bony chert with probably some concealed limestone.
2. Outcrop of limestone, generally bituminous with some blue clay in pockets.
3. Thirty feet of blue clay shale in valleys. It may be of more recent age than 1 and 2.
4. Fifty feet of gray crumbling bituminous limestone.
5. Twenty to thirty feet of chert in irregular broken layers, some altered to quartzite, with pockets and bands of blue clay. This is only reached by deep mining.

Bitumen is more abundant in the limestone beds, where it occurs sometimes as stains and in drops, and is also found in the form of solid asphalt.

Galena occurs in the Upper limestone but not abundantly, generally in the

form of cubes. It is more abundant in the broken chert beds. Beautiful octagonal crystals occur and we find them arranged in handsome clusters.

Zind blend (sphalerite) is chiefly abundant in the chert beds, acting as a cement to the broken fragments of chert, the whole appearing as a coarse breccia. The dark chert often contains disseminated blende; the white does not, but blende is often seen crystallized on the chert.

The general position of the strata in the mines is an approach to horizontality, but they undulate very much in the mines. In sinking the shafts the chert beds (No. 5,) are reached at eighty feet or more below the surface. They are much broken and sometimes do not seem to be at all stratified.

The lower chert beds (No. 5,) or mineral-bearing rocks, are of a white, gray, or dark blue. The ore is rarely contained in the chert itself, but is chiefly confined to the surface of the rock, but the darker colored rock sometimes is porous and includes mineral ores, apparently a replacement of the dissolved rock.

The clay bars, or bands, or pockets, rarely contain valuable minerals, but often contain a good deal of iron pyrites either in crystallized forms or else thoroughly impregnating the shale so as to darken it.

The darker chert is sometimes colored by the zinc ore. It also passes into a densely crystalline quartzite.

The ores are also sometimes found occupying drusy cavities which are sometimes beautifully studded with minerals. In them we sometimes find zinc blende, sometimes calcite, sometimes dolomite.

In the North Carterville mines a dark banded quartzite was observed, showing obscure deposits of zinc ore at the junction of bands and also disseminated ore.

At one place in the mines, the lowest seen rock was a dark banded quartzite, and a breccia of calcite, chert, and blende, with a deposite of galena just above. At another place found bituminous limestone. The quartzite sometimes presents a bony structure and incloses blende. Blende also occurs in cavities with pyrites crystallized upon it. Dolomite was found occupying spaces between the blende crystals. The granular blende is apparently of older age than the crystallized. The galena generally seems to be older than the blende, but sometimes they are of equivalent age. The pyrites is younger or newer than either. Their order of formation is about as follows:

I.—1. Galena, blende.
2. Galena, pyrite.
3. Galena, dolomite.

II.—1. Blende, pyrite.
2. Blende, dolomite.
3. Granular blende, crystallized blende, or condensed thus:

Galena,
Granular blende.
Crystallized blende.
Dolomite, Pyrite, Calcite.

The dark quartzite is newer than the white chert, as is proven by its containing fragments of white chert. The breccia is cemented by silicious matter, and by sulphuret of zinc.

Finally, the following is about the succession of mineral phenomena:

1. Geological period. Formation of limestone and white chert.
2. The rocks were fractured.
3. The limestones were partially disintegrated, and sometimes dolomized. Some ores were probably deposited.
4. Some of the chert was altered to quartzite. Ores deposited. Cementing of angular fragments of rock into a breccia.
5. Deposits of sulphurets of iron, oxides of iron. Deposits of calcite and dolomite.

From the above we find a certain resemblance to other mines of the southwest, but the Carterville mines are remarkable for excess of zinc ore, and small quantity of lead ore. Neither carbonates nor silicious ores were observed. On one specimen of zinc blende there was observed a minute stellate deposit which may be silicate of zinc.

LIST OF FOSSILS IN KANSAS CITY AND VICINITY.

WM. H. R. LYKINS.

The fossils of Kansas City are found in the rocks of the Upper Coal Measures of the Carboniferous system. It is not presumed that the following is a full and correct list of all our fossils, but only such of them as we have been able to identify with the means at hand; and probably a few of the names we have given will have to be corrected in the future. The march of improvement is rapidly obliterating many of our best localities, and it has been thought best to put upon record what we have found; for instance, the *Conularia crustula*, a very rare fossil in the U. C. M., has only been found in a very limited space, and that will have soon disappeared. We have also quite a number of species and varieties yet to be described and named, especially in the Cephalopoda, Fishes and Plants. The Plants we have not attempted to name, as they would require a specialist in that particular branch of palæontology. The many railroads centering here bring rock-ballast from long distances out on their roads. These rocks often contain fossils not found in this city or vicinity, and a stranger finding them and referring to our list would think we had been very careless in overlooking them. The beautiful little fossil *Syntrilasma hemiplicata* is found quite plentiful in the ballast of the A., T. & S. F. road in the city, but none has been found in place nearer than Eudora, Kansas, about twenty-five miles distant. Such fossils we have marked with an asterisk (*) when they have not been found in our local rocks. Hardly any one collection in the city will be found to contain *all* the fossils on the list but all that we have named have been found here and in the immediate vicinity.

For many of these names and identification of the fossils I am indebted to Mr. W. J. Parrish, who has one of the best local collections in the city.

PROTISTIS.—Fusilina cylindrica.
Ptychostylus heterocostalis, nov. sp. (Gurley, 1884).

RADIATA—*Crinoidæ.*—Archæocidaris, sp.
Eupachycrinus verrucosus.
" sp.
Schaphiocrinus hemisphæricus.
Zeacrinus mucrospinus.
" acanthoporus.

Corals and Bryozoans.—Axophyllum rudis.
Campophyllum torquium.
Fenestella Shumardi.
" sp.
Fistulipora nodulifera.
Lophophyllum proliferum.
Polypora submarginatum.
" sp.
Rhombopora lepidodendroides.
Syringopora multattenuata.
Synocladia biserialis.

BRACHIOPODA.—Athyris subtilita.
Chonetes granulifera.
" glabra.
" Vernuiliana.
Discina nitida.
" sp.
Hemipronites crassus.
" crenistriatus.
Isograma (chonetes) millepunctata, rare.
Lingula carbonaria?
" scotica.
Meekella striato-costata.
Orthis carbonaria.
Orbiculoides, sp.
Productus costatus.
" longispinus.
" Nebraskensis.
" Americanis.
" Prattenianus.
" punctatus.
" pertenuis.
" semireticulatus.
" symmetricus.

BRACHIOPODA.—Rhynconella, sp.
Retzia punctilifera.
Spirifer cameratus.
" lineatus.
" planoconvexus.
Spiriferina Kentuckiensis.
Terebratula bovidens.
*Syntrilasma hemiplicata.

GASTEROPODA.—Bellerophon carbonarius.
" crassus.
" Marcouianus.
" Montfortianus.
" percarinatus.
" textilitformis.
Euomphalus pernodosus.
" rugosus.
" subquadratus.
Lepetopsis Parrishi, new, (Gurley, 1884).
Loxonema multicostatum.
" rugosum.
" semicostatum.
" sp.
Machrocheilus gracilis.
" intercalaris.
" var. pulchella.
" medialis.
Murchisonia, sp.
Naticopsis Altonensis.
" var. giganteus.
" monolifera.
" nana.
" subovatus.
" ventricosus.
" Wheeleri.
Platyceras Nebraskensis.
Platyostoma Grayvillensis.
Pleurotomaria Broadheadi.
" conoides.
" depressa.
" Grayvillensis.
" Missouriensis.
" Newportensis.
" perhumerosa.
" subscalaris.

GASTEROPODA.—Pleurotomaria sphærulata.
" turbiniformis.
" tabulata.
" valvatiformis.

LAMELLIBRANCHIATA.—Astartella ?
Allorisma costata.
" granosa.
" subcuneata.
" subelegans.
Avicula longa.
Aviculopecten carboniferous.
" Coxanus.
" Hertzeri ?
" occidentalis.
" Providencis.
" neglectus.
Aviculopinna Americana.
Conocardium ? sp.
Cypricardinia carbonaria.
Entolium aviculatum.
Edmondia Aspinwallensis.
" glabra.
" Nebraskensis.
" reflexa.
" subtruncata.
Lima retifera.
Macrodon tenuistriata.
" obsoletus.
" sp.
Modiola subelliptica.
" sp.
Monopteria longispina.
" gibbosa.
" sp.
Monotis ? gregaria.
Myalina Kansasensis.
" perattenuatta.
" recurvirostris.
" subquadratus.
" Swallowii.
" sp.
Nucula ventricosta.
Nuculana bellistriata.
" *var.* attenuata.

LAMELLIBRANCHIATA.—Pinna peracuta.
Placunopsis carbonaria.
" recticardinalis.
Pleurophorus oblongus.
" tropidophorus.
" sp.
Prothyris elegans.
Pseudomonotis radialis.
" Hawni.
" *var.* sinuata.
Schizodus Curtis.
" Wheeleri.
Solenomeya radiata.
" rhomboidia.
Solenopsis ? sp.
Streblopteria tenuilineatus.
Yolda Stevensoni.
" carbonaria.

CEPHOLOPODA.—Discites Toddanus, new, (Gurley, 1884).
" sp.
Goniatites planorbiformis.
" politus.
" minimus.
Nautilus ferratus.
" occidentalis.
" Missouriensis.
" nodoso-dorsatus.
" sp.
Orthoceras aculeatum.
" cribrosum.
" sp.

PTEROPODA.—Conularia crustula.

CRUSTACEA.—Phillipsia major.
Cythere ? sp.

VERTEBRATA—*Fishes.*—Antliodus, sp.
Cladodus mortifer.
Deltodus angularis.
Helodus, sp.
Orodus, sp.
Petalodus destructor.
Peripristis semicircularis.
Xystrodus occidentalis.
Fish-spines undetermined.

PLANTÆ.—Calamites cannæformis, rare.
Cyclopteris? sp.
Neuropteris, sp.
Pecopteris, sp.

From the Lower Coal Measures at Rosedale, Kansas, four miles south of the city, the fossils are found on the dump from the bottom of the coal shaft, which is about seven hundred feet deep.

LAMELLIBRANCHIATA.—*Cardiomorpha Missouriensis.
*Aviculopecten rectileratarius.
CEPHALOPODA.—*Nautilus, sp.
*Goniatites, sp.
FISHES.—*Petrodus acutus.
*Petrodus occidentalis.
*Listracanthus hystrix.
IN THE LOESS.—Helix, sp. 2.
Pupa, sp.
Succinea, sp.
Teeth and fragments of bones of Mastodon.
Teeth and incisors of Rodents.

GEOLOGY IN GENESIS.—II.

S. H. TROWBRIDGE.

In the first part of this article attention was mainly directed to the origin and development of the inorganic portions of our earth; in this, we notice more particularly the mode of introduction of its organized beings.

The formulated expressions, "Let the earth bring forth," "Let the waters bring forth," and again, "Let the earth bring forth," impress the mind with the idea of parturition, and suggest the question whether God's plan of creation was by *fiat* or by secondary agents—whether mediate or immediate. The most absorbing question of the age, (unless, perhaps, we must except pleasure-seeking and money-making), is in regard to the origin of the thousands of living forms which have peopled and do people our earth. It may be threadbare, it may be even offensive to some, but it is the question which still perplexes the *thinking world*, and, like Banquo's ghost, will not down at their bidding. The oft-repeated formula, "after his kind," relating to the introduction of plant and animal life upon the earth, is considered by many as destructive to the development hypothesis of Darwin and others. Morris understands by it that every animal "produces its own kind and its own kind only through all the successive generations." Lyell says: "Each and every species was endowed, at the time of its creation, with the attributes and organs by which it is now distinguished." Principal Dawson claims "we are taught by this statement that plants were created each kind by

itself, and that creation was not a sort of slump-work to be perfected by the operation of a law of development, as fancied by some modern speculators." Dr. Clarke says, "Every plant and animal was *so* made as to produce its own kind through endless generations." But when he adds: "This is proof that all future generations of plants and animals have been seminally included in those which God formed at the beginning," he admits as much of the theory of evolution as its most confident supporters claim. He even out-darwins Darwin. Agassiz holds that animals of different species, and also of the same species, and even the various races of men, were separately created in many different localities.

Moses tells us plants were created on the third day, and no mention is made of any further creation of plants. The only recorded creation of aquatic animals was on the fifth day; and of land animals on the sixth day. And the record conveys to our minds the idea that the work of each day was presented for God's revision or inspection, and in each case "God saw that it was good." The works "were in weight and measure perfect and entire, lacking nothing," as Adam Clarke interprets it. We would, therefore, be led to expect no additions thereto in the future. But if geology teaches us anything, we there learn that *all* land plants by no means came into existence before aquatic animals, and that many of the latter made their first appearance after the formation of land animals. Geologists do not find land plants first or in the lowest rocks, but find marine animals and plants about the same time. But in the rocks above those containing these two forms of life, and consequently of later origin, are found remains of immense quantities of land plants. These plants are not the same as any now living. Above the strata containing ancient forms of plants are found new forms of marine life, and higher still appear still later and entirely distinct forms of both plant and animal life. Every new form coming in before or after the period devoted to creations of that particular kind of life comes in without any Bible record. Now, if on each creative day the work was made so complete as to be pronounced good, we seem driven to one or the other of two conclusions: 1. That each extended beyond the dawn of succeeding days and even to recent time, which seems to have no warrant in Scripture; or 2. That on each day God set agencies at work capable of completing the introduction of all forms and varieties of the peculiar kind of life to which that creative day was especially set apart. This points to the idea of secondary agencies or delegated powers, and leads us to suppose that at least some of God's creative acts were mediate rather than immediate.

A few years ago nearly all theologians and a large majority of geologists were believers in "special creation." But what is creation? Making out of nothing. But *how*? What do we know of God's *method* of creation? In his *word* he does not tell us except by implication, and if we ever know, this side the grave, it must be from his works. And, no doubt, the mere implication of the Bible, instead of positive statement, is designed to induce us to study nature to find out. "It is the glory of God to *conceal* a thing, but the *honor* of kings to *search out* a matter." Now looking as deeply as *we* can into this question, how do *we find*, I mean by our own observation and experience, that God created?

Does all or any of the life of which we have any present knowledge first appear full-grown, complete in form and parts, and with perfect adaptation to the ends of its mature existence? Do we not see at first only a speck, a germ, a motionless seed or egg; and do we not know that the full stature of any plant, animal or man is reached only after a more or less slow and long-continued process of development? Yet the general idea of creation has been that it must be instantaneous. Where did we get the idea? The only answer I can find is the echo —where!

The fact that God looked upon the completed work of each day, and saw that it was good somewhat reminds us of a proprietor inspecting work performed by secondary agents. If we accept the nebular hypothesis we must conclude that the members of our solar system were formed through the natural development of physical law rather than by special and immediate creation. Dr. Cocker, a strong adherent to the doctrine of divine agency in all creative work, after careful study of the original finds that the Hebrew *bara*, meaning absolute creation, occurs only three times in the first chapter of Genesis. 1st, in verse 1, referring to the creation of matter; 2d, in verse 21, to the creation of animal life; and 3d, in verse 27, to the origination of spirit-man in the image of God. These three creations of matter, life and mind, he claims are the only *creative* acts or actual *originations*. All others were *formative*, and formation supposes a something to be formed. If this be true, *vegetable* life was *formed* and was an outgrowth from pre-existing material. This may give a deeper meaning to the command. Let the *earth* bring forth plants; and *reminds* one of Tyndall's "promise and potency" of matter.

One with much experience in examining the fossil-bearing rocks of the earth's crust, can hardly fail to be convinced, if all the fossil forms which are *called* distinct species are really so, that, so far as outward form and occasional internal structure indicate relationship, many species are genetically related to each other. Any considerable collection will furnish specimens called by different names, and said by trusted authorities to be entirely distinct, found in different layers of rock, in which it would be extremly difficult to find as much difference as appears between brothers and sisters of the same family, or between leaves from the same tree. It is easy to arrange series of fossils, said to represent different species, which so run into and overlap one another in their resemblances that it would be safe to challenge any one to draw a satisfactory line of distinction between them. But this is far from proving evolution or even mediate rather than special creation. It may only argue, as I believe it does, that the term "species" is used in too restricted a sense. Till scientists and theologians can agree as to the definition of species, at least among themselves, it is idle for one to say what he does or does not believe in regard to the origin of species.

Dr. J. W. Dawson, who is doubtless the most active and most trusted champion on this side the Atlantic, of conservative views upon this subject, and who deals the most effective blows against what he calls "the modern gospel of evolution," renders "after its kind" as after its *species*, and holds that the "flora

of the third day must have had its place before the Paleozoic period of geology; also that "no plants of the older and middle geological periods now exist." "We may therefore rest assured," says he, "that the vegetable *species*, and probably also many of the generic and family forms of the vegetation of the third day, have long since perished, and *been replaced* by others suited to the changed condition of the earth." But, if each plant propagated its own species only, as he asserts, it is difficult to account for the introduction of the widely differing species which appeared later than the Paleozoic period, and replaced the "created" forms. As they could not, in his view, be developed from the first forms, there must have been creations of plants after the third day, of which we have no record in the Bible; for he allows us to conceive of no conservative way in which the old could have been replaced. And the difficulty is increased when we understand that the plaudit "good," pronounced upon the work of each day, indicates that the work was already complete. The Doctor explains his position in these words: "The introduction of new species of animals and plants has been a continuous process, not necessarily in the sense of derivation of one species from another, but in the higher sense of the continued operation of the cause or causes which introduced life at first. This, I take to be the true theological or scriptural as well as scientific idea of what we ordinarily and somewhat loosely term creation." He further remarks: "The formulæ in Genesis, 'Let the land produce and let the waters produce,' imply some sort of mediate creation through the agency of the land and the waters, but of what sort, we have no means of knowing. They include, however, the idea of the origin of the lower and humbler forms of life from material pre-existing in inorganic nature." This is essentially the position of Dr. Cocker, as already shown. One more quotation from Dr. Dawson, will suffice: "The term 'evolution' need not in itself be a bugbear on theological grounds. The Bible writers would, I presume, have no objection to it if understood to mean the development of the plans of the Creator in nature."

Prof. Dana, another acknowledged and honored light on the theistic side of this controversy, asserts that a conclusion most likely to be sustained by further research is this: "The evolution of the system of life went forward through the derivation of species from species, according to natural methods not yet clearly understood, and with few occasions for supernatural intervention."

I have said this much on the mooted subject of the origin of living forms in nature, in the first place, because a thorough study of either Genesis or geology requires it, and, secondly, with a desire to show that in reality theistic students of nature hold views essentially the same as their materialistic co-laborers, *so far as the facts in nature are concerned.* The only real difference is in the *interpretation of these facts.* But here the gulf which separates them is as deep and yawning as that between the monkey and man. The one claim that all the processes of nature are due to forces *within physical nature herself*; and these, so far as their study of nature is concerned, ignore the agency of God in it. To this extent they are Godless, but it does not follow that, outside of their study of nature, they may

not believe in God and reverently worship him. Men are *too apt* to look upon this class as sole representatives of scientific thought, and all belief in evolution is condemned because of the supposed heterodoxy of this one school. The other, which embraces no inconsiderable part of the scientific world, believe in evolution *as the work of God and his method of creation*. Geology furnishes abundant evidence—though not conclusive—that God's plan of creation was by some form of evolution. Now if we are ever forced by facts revealed in nature to accept this or some other mode of creation which we had not foreseen and which is not in harmony with our previous belief and habits of thought, will it not be *God's work still?* If it be said that these changes in nature take place without any aid of Divine power, I most emphatically object. "God upholds all things by the word of his power." "All things were made *by Him*, and without Him was not anything made that was made?" But if it be said that evolution or development is God's plan of creation, I must confess that I see no reason for denial or objection and no cause for fear of the consequences. That this is or is not his plan, however, neither science nor Scripture has yet positively assured us. Whatever may have been God's method of creation, it ill becomes short-lived and short sighted man to suggest what to his mind would have been a better method of procedure.

I have used the word "day" thus far without any reference to the length of time the word is meant to indicate. Bible students and geologists now agree that the creative days were not twenty-four hours in length, but indefinite periods of time. This is one among the many instances in which a knowledge of nature has changed our interpretation of Scripture. That geology teaches this has been incidentally, though I trust sufficiently, demonstrated in the great length of time required for the stupendous changes of which there are abundant evidences in the structural history of our earth. That Scripture teaches it, is abundantly established in various ways. It is enough for our purpose merely to refer to the different senses in which the word day is used in different parts of the Bible: "One day is with the Lord as a thousand years and a thousand years as one day." "A thousand years in thy sight are but as yesterday, when it is past, and as a *watch in the night*." It is derogatory to the infinite God to restrict him and his ways—his days of work and his day of rest—to the narrow limits of our ways and times. "As the heavens are higher than the earth, so are my ways higher than your ways and my thoughts than your thoughts." Prof. Dana has said: "A Deity working in creation, like a day-laborer, by earth-days of twenty-four hours, resting at night, is a belittling conception, and one probably never in the mind of the sacred penman." God had no need of rest after the labor of the creative days. "The Creator of the ends of the earth fainteth not, neither is weary." He simply ceased from *creative* work and now, in his long seventh day, devotes himself, so far as our earth is concerned, to works of love and mercy for the further benefit of the favored beings for whose abode he had created the earth. The creative days were "God divided days and nights in distinction from sun-divided"—(Cocker). Even in the first two chapters of Genesis we find several

senses in which the word is used. "God called the light day." This light has been shining ever since, hence *this* day is perhaps as long as time itself. "The evening and the morning were the first day." The evening was the darkness of chaos and extended from the beginning to the time light first appeared. As this time is indefinite the length of the remainder of this day is equally so. The "evening and the morning" before the appearance of the sun, and the "evening and the morning" after its appearance are alike called a day. In verse 14 the word day is used both to indicate the hours of light in the 24 hours, and also the whole 24 hours. And in the fourth verse of the following chapter the word day is used to designate the whole period of creation.

The order of succession, as shown by both the records, has received so much attention that but little more concerning it need be said. In general, we find that the order of plants and animals, as they appear in the rock formations, is strikingly in harmony with the order recorded in Genesis. Each reveals the fact that the lowest in the scale of life were mainly the first to appear; though both records, as we now interpret them, show that the gradation from the lowest to highest was not a uniform and unbroken one. It must be admitted that the record of the rocks has as yet been but imperfectly deciphered. This, however, is often admitted or denied according as one position or the other best serves the ends the party has in view, and the conclusions he wishes to reach. On the other hand, in the brief Bible record, while we are profoundly convinced that it contains the truth and nothing but the truth, and that no future discoveries in geology will make it appear any less true, it is highly probable that from a scientific standpoint, it does not contain the *whole* truth. In view of the fragmentary nature of each, the harmony is too marked to be reasonably attributed to chance, or to fail in convincing a candid student of both that the two revelations have a common author and a common purpose. With the best light to which I have found access, after considerable pains-taking research, I would say in recapitulation that the panoramic vision creation of which Moses saw, contained the following pictures, and that they are equally correct illustrations of the book of nature and the book of Genesis: After the blackness of darkness which preceded the energizing of matter, the first picture was of a light diffused through space, presenting to the inspired spectator no distinct object, but simply a glare of dazzling brightness; then he saw the solar system broken up into separate planets with clear sky between them; next the first grand upheaval of the land above the universal ocean of our own planet; then a luxuriant growth of terrestrial vegetation upon it, as in the carboniferous period of the geologist; then the appearance in full view of the sun, moon and stars; after this the land, water and air swarming with sea-monsters and reptiles of both sea and land, the bird-like reptiles, saurians, pterodactyls, etc., and the reptilian birds of the Mesozoic age; finally appear on the screen the monstrous sloths and other mammals of Cenozoic time as the megatherium, mammoth and mastodon; and lastly man appears to crown the whole.

According to geology and to Genesis, man appeared when in the fullness of

time all things had been prepared for his reception, and the earth fitted to be his happy abode. It is doubtless true, as Dana says, if the earth's history had closed in the Reptilian age we might have supposed it to be the work of a demon. But, fortunately it did *not* close then. And there is abundant evidence, both in nature and revelation, that the highest happiness of the highest inhabitant of this earth was the central thought during its whole history.

The subject of this article embraces references to the earth's history contained anywhere within the limits of the book of Genesis. There are many such allusions which we must pass unnoticed. Prominent among these are such as refer to the origin, distribution and unity of the various races of men. These suggest, for collateral information from the book of nature, the study of pre-historic man by means of the implements, utensils, earthworks, and other remains which are so widely distributed on the surface of the earth; also the tracing of the earliest wanderings, the traditions, and the physical, linguistic, and other peculiarities of existing races. The history of the flood of Noah is another item of rich geological interest; but the fewest possible words in regard to its universality are all that space will allow. This deluge was long regarded as universal, and even now it is by no means difficult to find men who suppose that the numerous strata of rocks, with their buried dead which have left their epitaphs upon their horizontal tombstones; the deposits of sand, clay, and gravel in alternating layers, and the countless evidences of erosion and displacement of material by water, are all and alike referable to the flood of Noah recorded in the Bible. To say nothing of the absurdity of the notion that fifteen or twenty miles in thickness of aqueous deposits, with their widely varying forms of plant and animal life, could be found in a single year; the want of water to submerge all the elevations of the globe; the lack of space in the ark for the thousands of animals upon the whole earth; and the improbability—if not impossibility—that the few which the ark contained could have multiplied and distributed themselves over the entire surface of the globe in the time which has transpired since the flood, have led students of geology to conclude that the Deluge extended over only those portions of the earth which were occupied by the peoples whom God had sworn to destroy. And *now* we see that the language of *Scripture* bearing on this point does not indicate universality in any stronger terms than such passages as—"every creature under heaven," "uttermost parts of the earth," "under the whole heaven," and many others, which we know from the context to refer to only a restricted portion of the earth's surface.

No one is asked to accept what is here for brevity's sake suggested rather than said, solely on the author's *ipse dixit*; nor should any reject it simply because hitherto he may have thought differently. Whether these views be considered tenable or not, if they may induce others to pursue a similar line of inquiry, I think such will agree that the study of the two records side by side is not only delightfully fascinating and exalting, but is the best, if not the *only* way to fully understand either.

COAL IN KANSAS FOR 1883.

I make a few extracts from the report of E. A. Scammon, State Inspector of Mines, which has just been published:

It has been a considerable task to get from some operators a statement of mine productions; while many have been prompt and business like, yet there are a few to whom I have made two and sometimes three visits for information, which could have been obtained in a few minutes if only attended to. However, the matter is now well understood and in the future much less time will be consumed in gathering material for these reports, This report has the merit of being correct and reliable, which will in a measure compensate for lateness. It embraces the coal production of the state for the last half of 1883; the number of miners employed in the mines, and outside laborers engaged in preparing the mine products for market; makes a calculation of the amount of coal mined by each miner in the six months; also the amount per day for each miner, allowing 150 working days in the time.

This average of coal mined per each miner is not entirely correct, from the fact that it is based on the number of miners at work in November and December, two months of usually active work in the mines, and the number of miners is larger in these two months than a general average of the whole six months taken together, hence the larger number of men for same quantity of coal, the lighter production per each man.

In Osage County there are eighty-four shafts (five are stopes, but are here, for brevity, considered same as shafts) located as follows: Osage City and vicinity, 33; Peterton, 5; Dragoon, 3; Burlingame, 12; Scranton. 17; Carbondale, 14. Of this number ten are worked out or abandoned, and in the month of December twelve were not operating, leaving sixty-two in operation, quite a number of these working but a few men. The shafts are all operated by horse power. Bushels of coal mined in Osage County, 4,722,367; number of miners, 1,518; mine bosses and weighers, 127. This distinction of men is made because miners are paid by the bushel, the mine bosses and other employes by the day or month. Amount of coal mined per each miner, 3,110 bushels; per day each miner, allowing 150 working days, 21 bushels; amount of money paid miners, $330,500; per miner, $317. Mining bosses and laborers not included; just actual diggers paid above amounts. Had the demand for coal been good, and mining active, the business would have been easily one-third larger, and these figures correspondingly increased.

In addition to above amount of coal, there was stripped coal in the vicinity of Scranton and Carbondale, 707,153 bushels; ninety teams and 120 men stripped coal.

Thus, in Osage County output of coal for last six months of 1883, 5,429,520 bushels. Miners employed, 1,564; laborers and strippers 201; total 1,765. This does not include operators, superintendents, office men, etc.

The coal mines of Cherokee and Crawford Counties are generally considered one coal district; the mines being located in the northern part of Cherokee and southern part of Crawford Counties, they are properly enough considered one district, and in this report I combine the two counties and give the business and output as one district.

There are twenty-five shafts, two of which are stopes; of these, all but two are in operation. Located north of Columbus, 4; Newcastle, 1; Stilson, 1; Scammonville, 4; Weir City, 8; Pittsburg, 5; Litchfield, 2. Of these, fourteen are operated by steam power, and eleven by horse power. Output of coal, 5,-706,877 bushels; number of miners, 817; pit bosses and employes, 215; amount mined per each miner, 7,095 bushels per each miner daily, allowing 150 working days, 47 bushels; amount paid miners, $217,000; each miner, $265. The average amount of coal mined by each miner appears small, but this calculation is made from the number of miners at work in November, which is larger than an aver- of six months would be. The business here would have been one-third larger had the demand warranted it, Stripped coal in this district, 235,000 bushels, employing 35 teams and 60 men. Total output in the district, 6,031 877 bushels; number actual miners, 835; engineers, laborers and strippers, 277; total 1,112 —operators, superintendents and office men not included.

Leavenworth County, 953,099 bushels. Number of miners, 200; other employes 162; total 362. Penitentiary shaft, 504,064 bushels. Number miners (convicts), 131; laborers 15; total 146.

There are several smaller mining districts in the State from which I have partial returns and some I have none. The reports I have I combine in the following statement from Ellsworth, Russell, Neosho, Franklin, Bourbon, and Linn Counties: Number of bushels of coal mined, 458,715; number miners, 103; number laborers, 16.

From the foregoing, the total amount of coal mined in the State of Kansas for the last six months in 1883 was, in bushels, 13, 377,875; in tons, 535,115. Number miners, 2,844; other employes, 671; total, 3, 504.—*Correspondent Kansas City Journal.*

PHYSICS.

TISSANDIER'S ELECTRIC BALLOON.[1]

I. W. COOK.

Aërial ascents were scarcely ever spoken of by classical writers, but are alluded to in one or two fables written before the dark ages. In one of these we

[1] Read before Penn College Scientific Association, Oskaloosa, Iowa, May 10, 1884.

have the account of a man and his son who wished to flee from an enraged king. Accordingly, they made wings of feathers stuck together with wax. The son, regardless of the warnings of his father, flew so high that the heat from the sun melted the wax. Thus deprived of his support he fell into the sea and was drowned. We have another account of a flying dove made of wood, but neither is authentic.

It is evident from history and other sources that the ancients considered it beyond man's natural powers to fly. It was regarded second only to the power of Jupiter to flash the lightning and hurl the thunderbolt. Such attempts were made generally by the lower class of projectors who possessed a little ingenuity and a smattering of mechanics.

In 1600 an Italian constructed a set of wings of various plumage and undertook to fly from the walls of Stirling Castle to France. But he fell very shortly to the ground. He gave as a reason of his sudden descent the fact that some of the feathers he had used were from birds that flew close to the earth.

One Borelli proved positively in a work issued 1680, the impossibility of man by his muscular strength, to be able to give motion to wings of sufficient extent to keep him suspended in the air. Although this fact be true, yet it does not make it impossible to have a flying chariot with power produced by machinery, or a boat so constructed that it will sail in the atmosphere. Even before it was clearly proved that men could not fly as birds such attempts were made, though in a very rough manner. It was nothing but ignorance of the nature and force of the atmosphere, as well as the properties of all aërial bodies, that caused so long a time to elapse before the invention of the balloon.

The first who comprehended, though in a very vague and erroneous manner, the principles on which a body might be made to float in the air was a monk, Albert of Saxony. In 1670, Francis Laua presented a still more rational view of the subject, which though useless,as it was not practical, yet introduced sound principles, which could be said of no earlier attempt. His idea was to have four copper balls twenty-five feet in diameter and one two hundred and twenty-fifth of an inch in thickness, attached to the four corners of a square basket and exhausted of air, and thus obtain an ascending force of twelve hundred pounds. But balls constructed in this manner would not even bear their own weight, much less the immense pressure of the atmosphere from the outside. In 1783, the real balloon was discovered by James and Stephen Montgolfier. They got their idea from watching the clouds. They noticed that they were suspended in the air, and thought if they could get enough of some such material in a captive state it would ascend. They filled small sacks with smoke, and found sure enough the smoke, or something else given off by the fire, did ascend and take the sack with it. Accordingly they made a linen bag one hundred and five feet in circumference and filled it with smoke from a straw fire. It rose to a great height, and descended in ten minutes, one and one-half miles distant.

The news of this ascension spread rapidly all over Europe. The excitement was so great that a collection was taken up in Paris, for the purpose of having the

the experiment repeated. The construction of a second balloon was undertaken by two brothers of the name of Roberts, assisted by a prominent Professor of Paris. It was made of silk, varnished with a solution of elastic gum. It was thirteen feet in diameter, and filled with hydrogen gas. As it took some time to inflate it, bulletins were issued daily regarding the progress. Near the time for ascension so many people had gathered that a detachment of soldiers had to be called to keep them back. August 27, 1783, at 5 P. M. a cannon was fired as a signal for the ascent. Upon being liberated it rose very rapidly about three thousand feet. At this time it began to rain quite hard, but the rain had no effect, neither on the balloon nor the spectators. Thousands of well dressed people, many of them ladies, stood exposed watching it. It remained in the air about 45 minutes and came down fifteen miles distant.

About this time the Montgolfier brothers repeated their experiment in the presence of the King and Queen, as well as many other spectators. Suspended below this balloon was a cage containing a sheep, a chicken and a goose, which are the first of the animal kingdom recorded as having ascended in this manner. The balloon, cage and contents descended safely in eight minutes, having reached a height of 1,500 feet.

The largest balloon on record was 100 feet in diameter and 130 feet high. It ascended in 1784, having been inflatec over a straw fire in seventeen minutes. Seven persons were in the car. It rose 3,000 feet, and descended in fifteen minutes.

Hundreds of balloons have ascended since the Montgolfier brothers sent up their linen sack filled with smoke, and as many have been the devices employed for their improvement or to render them controllable. Tissandier's electric balloon seems to reach nearest the desired end. Tissandier claims that we should look upon the atmosphere as a vast ocean and a balloon as a boat so constructed that when launched far above all obstructions it can be propelled and guided through the air by a screw propeller and by a rudder in a manner similar to the way our screw propellers are moved and guided in the water. In accordance with their views they constructed (October of last year) their celebrated electric balloon. It consists of three distinct apartments; the air balloon, properly so called, a gas apartment for inflating, and the electric motor to give motion, that is, horizontally, by means of a screw propeller. This balloon is much greater in length than in thickness, having a length of twenty-eight metres and a thickness of nine and two-tenths metres through the middle, thus being almost cigar shaped. Its capacity is 1060 cubic metres. The netting over the balloon is made of ribbons, woven with longitudinal spindles which keep them in their proper geometrical positions. These make the outside surface much smoother than when cords are used. It is connected on the sides of the balloon with two flexible shafts, which perfectly conform to its shape when inflated. The car is in the shape of a cage made of bamboo rods strengthened by cords or threads of copper covered with gutta percha. It is attached to the ribbon net-work by ropes. The arrangement for guiding is a rudder a broad surface of unvarnished silk supported by bamboo

poles. This rudder is attached near one end to the under side of the body of the balloon, and so arranged that it is perfectly under the control of the operator.

The screw consists of two spirally curved paddles made of silk and bamboo poles, the deformation of which is guarded against by the action of coils of steel wire. Four batteries are so constructed and placed in the car that this screw can be given four different motions, varying from sixty to one hundred and eighty revolutions per minute.

The summer of 1883 was almost gone when the balloon was completed; therefore, it was given but one trial last year. This trial was made by Tissander and his brother. They began inflating it with hydrogen gas about eight o'clock in the morning and continued till half past two in the afternoon. At twenty minutes past three they made the ascent. On the ground there was almost no wind; but, as frequently happens, it increased with the altitude. On this account they did not let it rise more than four or five hundred metres. About four o'clock in the afternoon they made a very successful descent. The balloon was left inflated over night, as they expected to make another trial the next day, but on account of the coldness of the night the bicromate of potassium in the tanks had crystallized and the battery, which was by no means exhausted, was on this account, however, incapable of action. They were able in their last year's ascent, by the use of the screw, to stand still against a strong wind, and when drifting with the wind by a slow motion of the screw a much greater speed could be obtained than that caused by the wind. They could also maintain any desired angle with the direction of the wind by the use of the rudder. However, they found that when holding the balloon in a position at right angles to the direction of the wind the rudder became inflated like a sail and a series of gyratory motions before noticed became more violent. From this they conclude that the balloon should not be held in a position at right angles to the direction of the wind.

These brothers, as well as many others, feel sure that successful aerial navigation will soon be no more a thing of the future, but of the present. They consider this first ascent as merely a preliminary trial which will soon be repeated with the alterations which their experience commands.

HISTORY.

THE CONSPIRACY OF BARRERA—A REMINISCENCE OF THE EARLY HISTORY OF MISSOURI.

OSCAR W. COLLETT, CUSTODIAN MUSEUM, MISSOURI HISTORICAL SOCIETY.

In 1761 the king of France made a gift of Louisiana to Spain. The gift was accepted with reluctance, as its advantages were questionable, indirect at best,

and it was certain to occasion an annual expenditure of money largely in excess of any income it could possibly yield. The Spaniard, accustomed at all times to move slowly, in the present instance was in no haste to assume an onerous burden; and accordingly it was in the spring of 1766 only that Antonio de Ulloa, the newly appointed Spanish governor, arrived at New Orleans to take possession.

It had been agreed between the two courts that the French troops in the province, about 300 in number, should, if needed, serve under Spain for the time being; and it not being convenient just then to the Spanish king to send a sufficient force to the colony, Ulloa brought with him but two companies, ninety men all told, counting upon the garrison actually in Louisiana to make up what was necessary to the proper military equipment of the new government. But immediately after his arrival he found to his great surprise that notwithstanding what had been determined between the two kings, and the instruction to M. Aubry, the French commandant, to place his troops at the disposal of Spain's representative for such period as he should require, the French soldiery refused positively to enter the Spanish service, as their term of enlistment had expired. The new comers, therefore, could not take formal possession.

Under these circumstances it was agreed between Aubry and Ulloa that they would conduct the government conjointly as though the country belonged to Spain, the former to continue in command, but subject to the directions of Ulloa, until the arrival of the expected Spanish troops. The machinery of government thus devised was put into operation immediately, France ceased to supply funds, the entire expenses of the colony were at once assumed by the Spanish ruler, all public functionaries, ecclesiastical, civil, and military, thenceforward were paid their stipends and salaries out of the Spanish exchequer, and the French officers in charge of the several districts solicited and obtained from Ulloa the continuation of their commands.

Ulloa deemed it advisable to establish four new posts, as the English had built several on their side of the Mississippi, which he did with the approval of Aubry, and distributed among them his ninety men. One of the four was built at the mouth of the Missouri, probably on the same spot where La Salle camped in 1682 on his voyage of exploration, and named Fort St. Charles. It was a stockade fortification, of ample dimensions, with bastions, defended by five guns two of six and three of four pound calibre, besides small arms in abundance, and swivels for use as occasion required. The ammunition consisted of 126 cannon shot, 66 canisters of grape, quantities of lead bullets, and a large supply of powder. It was to be the storehouse of the goods sent up for distribution among the Indian tribes that were expected to visit St. Louis periodically as they had formerly visited Fort Chartres; and besides serving as a place of refuge in case of need, to guard the entrance to the Missouri river against interlopers from the English side, as well as unlicensed traders of Louisiana. Its garrison consisted of twenty men and some employes, mechanics and others who were not soldiers,

commanded in 1767 by Captain Francisco Riu. It may have been established in 1766, but not later than the summer of the year following.

After surrendering Fort Chartres to the English, on October 10, 1765, St. Ange, the French District Commandant, in obedience to orders had removed the remainder of his troop to St. Louis, which village was in the district of the Illinois, the seat of whose government had hitherto been at the Fort, and was in command when Riu's expedition arrived.

These strongholds were not intended to supersede the French establishments already in existence, and Fort St. Charles and its commander left St. Ange free to direct affairs as formerly, except as to the Indian trade, which was regulated by Riu. He issued the permits to traders and distributed the presents which Spain, in continuation of the French custom, provided for the Indian nations, through Milony Duralde, who had been sent up with the Spanish expedition as engineer and inspector of works. St. Ange and Riu were on the best of terms, and the Spaniard appears to have resided in the village.

St. Louis, as yet, did not produce sufficient food for its own wants, and the garrison of Fort St. Charles was dependent for its chief supply of provisions upon St. Genevieve. In November 1767, by order of M. Riu, an armed boat was dispatched from the Fort to St. Louis, in command of Sergeant John Gaillard, with one Paul Barrera, store-keeper of the post, on board, freighted with four thousand pounds of powder and goods for the Indians, with instructions to land the cargo at the village, proceed to St. Genevieve and bring up a return load of flour, salt, meat and corn, for the winter's supply of the establishment at the mouth of the Missouri. The boat arrived, delivered the goods to Duralde and the powder to Laclede for storage in his magazine; departed for St. Genevieve, procured what was needed and reached the village on December 2d, at mid-day.

Mischief had been brewing, probably concocted at Fort St. Charles some time previous, in which Paul Barrera, the store-keeper was the ring leader, and needed but a pretext to break out in open revolt. Soon after he landed the Sergeant reported to M. Riu, and was ordered to hold his men in readiness to resume the voyage in the morning. Next day a villager brought word to the Spanish commandant that Barrera was sick and could not leave, and had taken a room with one Marie in order to be treated medically. M. Riu therefore sent a message to Barrera to the effect that he had behaved improperly in not making known his illness yesterday afternoon; that if he was really sick he could remain three or four days, otherwise he must embark and return to his post, and requested an answer in writing. Receiving none, he sent again, when he was informed that the storekeeper had called in Surgeon Condé Meanwhile a violent north wind had risen and rendered navigation unsafe. M. Riu therefore deemed it prudent to put off the departure of his men for the day.

Early next morning, December 4th, the Spanish commandant sent word to the storekeeper by M. Duralde, to take his departure unless sick, as the King was not served by the troop remaining idle at St. Louis with the boat; and besides, it was a disadvantage to the Fort. The official replied that he felt much

better, and after dinner would come and see M. Riu; but as his answer gave no assurance of his intention as to departure, the commandant directed the sergeant to repeat the message. Presently the sergeant returned, evidently under the influence of drink, with word from the storekeeper that he felt much better, but had given himself over to the devil in hell; and the Sergeant having objected to carry such a message to his superior officer, Barrera had replied: "Tell him just what I said."

M. Riu reprimanded the Sergeant for not having come to him for the orders of the day, and for leaving for St. Genevieve without passport or instructions. The sergeant asked pardon for these irregularities and was forgiven. He then went on to say that yesterday he had issued orders to the troop to hold themselves in readiness for the morrow; but they declared they would not leave in the morning, and that he might obey M. Riu, but they would not; furthermore, that while at St. Genevieve, Gomez and Gousman, two of the soldiers, had refused to assist in loading or to work. Mr. Riu replied that he should put his statement in writing; which he did on the spot.

M. Riu then directed him to go once more to the storekeeper and ascertain whether it was his intention to embark, and to report in writing. Thereupon the sergeant answered, excitedly, that he would not, as his word was sufficient, adding that M. Riu was a false man, a two-faced man; that he demanded to know every thing, and, notwithstanding he had been fully informed, he required things to be put into writing that he might entrap and ruin him. M. Riu asked why he used such language, told him to contain himself and not to speak so excitedly and so loud; but he all the more spoke out, saying, he wished every one to hear his words, that what he had said was said, and M. Riu could make of it what he liked. As notwithstanding the Spanish commandant's patient forbearance, and efforts to persuade him to calm himself the sergeant only persisted in his unseemly language and conduct, he bade him go and take the orders of the storekeeper, since he disregarded those of his superior officer. At this Gaillard left, declaring he would compel by force the storekeeper to go on board.

M. Riu went immediately to the government chamber to communicate what had occurred, and consult St. Ange as to what was best to be done. The French official's quarters were in the central hall of the Maxent, Laclede & Co. factory, which seems to have been built specially with a view to accommodate the district government when it should be transferred to St. Louis from Fort Chartres, situated on the west side of Main Street, between Market and Walnut Streets, from which there was a full view of the river; and his soldiers' barracks were in the basement. They agreed to send for Barrera, which was done. One and the other pointed out to him his duty, and urged him to an effort to allay the excitement of the detachment, for both perceived that affairs were taking a serious turn; and, finally, M. Riu commanded him, in the name of the King, to take his departure for Fort St. Charles. To all of which the storekeeper only made answer that he was sick, and the king did not require that a sick person should set out on a journey; but if he must go, it would be only on a written order in

which it should be specified that he was ill at the time. M. Riu said that he would send for the surgeon who had attended him. Dr. Condé came immediately. He had been called in by Barreřa, who complained of sickness, of suffering from oppession of the chest, and asked to be bled; and as the patient insisted he had bled him accordingly; but there was no symptom whatever of fever. After this statement the storekeeper left the chamber, saying he would get ready to embark, meanwhile St. Ange had quietly given orders to his entire troop to assemble in the barrack-room.

Half an hour later there came a negro servant of the Spanish Captain to say that five or six soldiers were at his house, and wished to see him; but both commandants thought it better that the soldiers should come to the Government Hall, and the negro was directed to notify them accordingly. Fearing that insult and personal violence to M. Riu was intended, St. Ange ordered de Belestre to put the French guard under arms immediately, and station them in an adjoining room with instructions to be ready to act at a moment's warning. The command was obeyed on the spot as the guard was within call. The Spanish soldiers having come, for prudential reasons only three were admitted, and the others required to remain outside on the steps. After various remarks Fereco, the spokesman of the trio, asked who commanded the boat, the sergeant, or the storekeeper? On being informed it was the sergeant, after some words had passed, he said, the boat should not leave to-day, and that when it did the storekeeper must be on board, as he had started with it from the mouth of the Missouri. He proceeded to say further that neither he nor his comrades were willing to acknowledge M. Riu as their commander, or obey his orders, and that they would not have or recognize any one as their superior officer, except Lieutenant Ferdinando Gomez. After further disrespectful remarks and insubordinate conduct, the three left the chamber, and all six started for the boat to take their departure for Fort St. Charles, as St. Ange and M. Riu supposed.

Not a great while afterwards, the two commandants, still together in the council chamber, were startled by the discharge of a swivel. Montardy was immediately dispatched for the storekeeper. He found him already in the boat and two soldiers holding him by the collar. He notified Sergeant and Barrera that St. Ange wished to see them, but the former replied that the soldiers would not allow the storekeeper to go ashore. One Boyer, who had come up with the Spanish expedition as an employe and been substituted for another when the detachment left Fort St. Charles, was standing on the bank near the stone to which the vessel was moored. He was ordered to cast off the rope and come aboard immediately; and before Montardy could run up the hill to the government house St. Ange and M. Riu, who had come out and were standing on the steps, saw the boat push out into the river, turn her prow down stream, and the crew shouting "to the city," "to New Orleans," and discharging their guns, whose balls rattling against the cabins alarmed the villagers, begin to row lustily with the current.

As was reported by Boyer, who subsequently made his escape, some nine or

ten soldiers had conspired against M. Riu, and plotted schemes of which he knew nothing, not having been taken into their confidence. As the hour of setting out was late in the afternoon the consirators determined to camp for the night below the mouth of the Meramec. On the route Barrera said to his companions: "My friends, we must not separate. If you abandon me I will dash out my brains or drown myself." The soldiers answered that they would not desert him. The storekeeper continued: "We must go to Pensacola. If on the voyage to the city a French detachment sent in pursuit should overtake us and attempt our arrest, we must defend ourselves, and perish rather than be taken; and further, that he would kill or drown himself sooner than surrender; that M. Riu wished to ruin them; and it was better to perish as one man or to save themselves altogether." Upon this the soldiers promised to stand by him and by each other to the last extremity. Boyer further learned from their conversation that they had at first intended going up the Beautiful River, but not being acquainted with those parts had changed their destination for Pensacola.

The conspirators having arrived at St. Genevieve, the storekeeper wished to unload half the flour, but his companions objected. Barrera, the Sergeant and two soldiers went ashore to visit Mr. Vallé. Presently those who remained in the boat, whether they really intended what they said, or merely wished to get rid of him and afford him an opportunity to take himself off, ordered Boyer to go up to the top of the hill and keep a lookout for pursuers in case there were any, which he did. Finding himself at some distance from the landing and out of sight of his companions, and having been there for some time, Boyer began to turn in his mind the enterprise in which Barrera and the soldiers had embarked, and that they would be lost and probably pay the forfeit of their lives for their revolt, and concluded he had better get himself out of their company, lest he should share their fate. So, full of these disquieting thoughts, he furtively withdrew further from the river, plunged into the forest, made his way back to St. Louis, reported himself to M. Riu, gave an account of what had occurred while he was on the vessel and how he had escaped, not omitting to mention that he had lost all his little effects which were in a sack in the locker in the bow of the boat.

What finally became of Barrera and his fellow conspirators still remains among the secrets of the past; but their revolt and flight must have been known in New Orleans very soon after their arrival, as M. Riu had a boat armed, and dispatched immediately to the governor of the province with a full report of what had occurred.

To complete this hitherto unwritten, and somewhat romantic chapter of local history, we proceed to tell what happened to M. Riu during the remainder of his stay in Missouri. But that the narrative may be better understood, it will be necessary to go back a few years. In 1763, M. d'Abbadie, then commandant of the province of Louisiana, granted Maxent, Laclede & Co. the exclusive trade of the Upper Mississippi and Missouri rivers. This monopoly caused a great outcry among the New Orleans merchants; and on their remonstrance the French minister annulled the grant in 1765. Maxent, who had become a warm

friend of Ulloa, induced the Spanish governor to re-instate the company in the privileges it had lost, which he did in 1766. Riu, as we have already seen, regulated the Indian trade at St. Louis, and of course, as in duty bound, enforced the odious Maxent, Laclede & Co. monopoly in their interest. Naturally Laclede and all who were influenced by the company he represented were favorable to Riu. St. Ange, although in the service of Spain, happily for himself, was not required to take part on either side. As all the independent traders and the merchants who furnished their supplies were cut off by the monopoly, they became hostile to Ulloa, and those on the spot to Riu especially. Incited by the wrongs to which they were subjected, at one time a number of inhabitants and traders assembled and addressed a passionate remonstrance to St. Ange against the restrictive policy which was being enforced, and set forth the ruin with which they were threatened. With the rare tact which had ever characterized his conduct, St. Ange managed to pacify them with the assurance that their complaints should be forwarded to New Orleans, where no doubt they would receive attention.

Meanwhile the Autumn of 1768 had come, revolutionary proceedings at New Orleans taken place, and in consequence, Ulloa had left the province on November 1st. With his departure the Maxent, Laclede & Co. monopoly and other Spanish restrictions on trade disappeared, and also the occasion of complaint against M. Riu in St. Louis. On the eve of departure, Ulloa had agreed with M. Aubry that the four posts should be evacuated, his force replaced by French soldiers, and the Spanish troops sent to Havana.

News of what had occurred at New Orleans reached St. Louis in due season; but winter disappeared, the spring of 1769 came and passed, summer set in, still Riu and his little garrison tarried, the solitary representatives of Spanish power in Louisiana. Why should they leave? Spain, which regarded the loss of great interests with indifference, but not insults and contumelies, was sure to return in her might, and they could well bide the arrival of the coming avenger. The Spanish and French commandants on good terms, Riu spending most of his time in the village, his friends of the late Maxent & Co. monopoly owing him much good will, the traders no longer interfered with, harboring no grudge, his little garrison at Fort St. Charles an advantage to a country so sparsely populated, there seemed to be reason for his going. Besides, St. Louis was not implicated in the revolution at New Orleans; and St. Ange was far too prudent to allow himself to be made an accomplice, whatever the plausible Lafreuiere might say, or the wily Foucault write in favor of their conspiracy; and he knew too, how hostile Aubry was to all that had been done to Ulloa. He was ready to take charge of the fort when the Spaniard was ready to deliver it, for this was his duty; but for the rest he was determined to keep clear of all entanglements. Any how, it was only in the latter part of July that Labuxiere, the notary, and an officer and a few soldiers went up to the mouth of the Missouri, the first to make an inventory of the fort for the military authorities, the others to receive and hold possession. Spain's proud banner was slowly lowered, taken from the

mast and reverently folded, a little flotilla manned by the garrison cast off its moorings, discharged a farewell gun, and quietly dropped down to St. Louis. After a short delay to bring aboard a few things and to take leave, Riu got into his boat, the vessels shoved out into the stream, saluted the village with a volley, and soon were lost to sight. Doubtless the Spaniards left no unkind feelings behind.

The flotilla was in no haste to make a quick voyage; and ere it reached its destination it was met by a fast-speeding dispatch-boat with the Spanish colors flying, which communicated the joyful intelligence that Count O'Reilly with three thousand troops of the line, amid the roar of guns, and the rattle of musketry, and the shouts of many voices, had landed at New Orleans, and re-established the authority of Spain in Louisiana. From that day until the cession of the country to the United States, the flag of Spain on the shores of the Mississippi attested her absolute domination over the west half the valley. Fort St. Charles was dismantled by the Spaniards, the timber of which it was constructed soon decayed, successive floods left their deposits where it once stood, and in the course of years not a vestige remained—its memory is preserved only in history.

ST. LOUIS, MISSOURI, 1884.

THE GROWING POWER OF THE REPUBLIC OF CHILE.

Chile is in name and in an important sense a republic, and yet its government is an oligarchy. Suffrage is restricted to those male citizens who are registered, who are twenty-five years old if unmarried and twenty-one if married, and who can read and write; and there is also a stringent property qualification.

The population of Chile doubled between 1843 and 1875; the quantity of land brought under tillage was quadrupled; copper mines were discovered, and so worked that Chile became the chief copper-producing country in the world; some of the silver mines rivaled the Comstock lode; more than one thousand miles of railroad were built; a foreign export trade of $31,695,039 was reported in 1878; and two powerful iron-clads, which were destined to play a most important part in Chilean affairs, were built in England. Meanwhile, the constitution was officially interpreted so as to guarantee religious toleration, and the political power of the Roman Catholic priesthood diminished. Almost everything good, except home manufactures and popular education, flourished. The development of the nation in these years was on a wonderful scale for a South American State, and the contrast between Chile and Peru was peculiarly striking. Comparative purity and strength of race, born out of hardship and producing political stability and honesty and personal courage, seemed to be the prime factors in the Chilean distinction. And yet the two peoples were the descendants of the same European race and of kindred Indian races. Doubtless the difference in climate was entirely favorable to Chile.—*July Atlantic.*

ENGINEERING.

THE SEWERAGE OF KANSAS CITY.

G. W. PEARSONS, C. E.

In the January number of the REVIEW appeared the report of a lecture by Mr. O. Chanute, C. E., upon the sewerage of Kansas City. Another paper in the February number gave a concise description of the Memphis sewers, which are upon the "Separate system" advocated in Mr. Chanute's paper.

This important subject has attracted the attention of engineers elsewhere. *Engineering News* of New York republished Mr. Chanute's paper in its issue of the 19th of February, together with a note from the author inviting criticism, and the invitation thus given was taken up by Mr. R. Moore, C. E., ex-Sewer Commissioner of St. Louis, who on the 12th of March read before the Engineers' Club of that city a paper in review of Mr. Chanute's lecture.

The latter was present on that occasion and made a verbal reply, which he was requested to write out by a vote of the club, and both the review and the reply were published in the "Journal of the Association of Engineering Societies" for March, 1884, and subsequently republished in *Engineering News* (April 26th, May 3d and 10th).

This led to further discussion. Mr. Allen D. Conover, of Madison, Wis., wrote to *Engineering News* concerning the point made by Mr. Moore as to the obstruction to traffic by water in cross-gutters, and was replied to by Mr. C. E. Chandler, of Norwich, Conn.

Two additional papers on the same subject were read before the Civil Engineer's Club, of St. Louis, on the 7th of May by Mr. R. Moore, C. E., and Mr. R. E. McMatt, C. E., and these have also been published in *Engineering News* together with a letter from Mc. J. H. Humphreys, C. E., of Memphis, and also one from the writer, so that it is evident that there is no lack of interest in the subject among engineers.

As the people of Kansas City are, after all, the most vitally interested in this subject, it is hoped that a review of the arguments will command their attention. The articles which have appeared in the pages of the REVIEW do not need more than mention here, those which have appeared elsewhere need for these pages a fuller transcription, but the limits of this article will prevent more than an outline of their arguments being given, with a view to deduce from them and other data some general ideas of what may be best here.

First. What is the difference between the combined and separate systems of sewerage?

The earliest use of sewers in modern times was for the carrying of storm-

vater. The use of them for carrying domestic waste is comparatively recent and he carrying of storm-water and household waste together, is known as the com bined system.

The separate system of sewerage leaves the storm-water sewers to do the vork for which they were originally intended, and provides separate sewers for ousehold waste. These are very much smaller than those used in the combined ystem, and are provided with means of cleansing, periodically, by flushing with vater. Mr. Moore argues that as storm-water sewers must be built, it is unneces- ary to duplicate them with smaller sewers, that the history of sewerage does not bear out the claims of superior sanitary conditions in the separate system, and hat instead of being an economy it would result in a final expense greater than hat of the combined system. Cites the example of Croydon, England, the ealth of Memphis, and gives a distance of 1,000 feet as the limit that may be llowed for water to run in surface-gutters before being carried below the surface; hese will be taken up later. In a subsequent paper he makes a proportion of ne mile of storm-water sewers to two miles of the separate system, but it is not ntirely clear whether it is to be taken as meaning that one mile of storm-water ewer would be required for a district containing two miles of other sewers or whether they should be counted as three miles, each doing its share of the whole.

In Mr. Moore's citation of Croydon he states that six-inch and four-inch ewers were replaced with larger sizes, and the ventilation improved, greatly im- roving the sanitary condition of the city, and infers that the improvements since nade in ventilation, and flushing by means of automatic flush-tanks, are not of o great importance as to constitute a valid claim to its being a new system. He lso considers that Mr. Chanute's claim that the sanitary condition of Memphis s greatly improved by the system of sewerage adopted, is not well founded.

As to the first, so many cities, both here and in Europe, are adopting the istinctive system known as the Waring separate system, that it would seem that he many engineers who have these works in hand could hardly be mistaken in scribing the credit of it to Mr. Waring, and especially when the city of Paris, fter a year's study by the best scientists and engineers of France, deliberately dopted the system, called him to make the initial experiment, and have since alled on him for plans for some seventy miles of additional sewers. If a con- ress of European engineers, after mature study, unite in giving Mr. Waring credit or great and valuable improvements, it would seem that his countrymen might lso afford to give him what credit may justly be his due—for so far as the bugbear f his patents and royalties are concerned, they do not amount to a tithe of the conomy which can be attained by their use. And in a country whose mechan- cal and engineering achievements have been largely due to the character of our atent laws, these ought not to be a barrier to taking up anything that promises conomy and improvement.

With regard to the sanitary condition of Memphis, the writer spent a year or nore there, leaving just as the yellow fever broke out, has visited the city several

time since the sewerage system was inaugurated, examined its workings, conferred with the authorities and leading citizens, and considers that Mr. Chanute's claims are fully justified. That city has for some years been growing nearly as fast as this, and it is greatly due to the feeling of safety from epidemic diseases which the improved sanitary condition of the city has given.

Regarding the passing of storm-water under ground, Mr. Moore considers 1,000 feet (from the crest of the water-shed) as the maximum distance that it should be allowed on the surface. As water runs slower and accumulates more on flat than on steep grades, using this as an average we would have from two to five blocks from the crest of the water shed in which it is unnecessary to construct storm-water sewers. Mr. Conover, of Madison, Wisconsin, considers the nuisance of storm water much less than Mr. Moore does, and the experience of the writer in Memphis, being in the streets very much of the time for a year or more, in all weathers, is similar.

The City of Baltimore with 322,000 inhabitants has but eleven miles of storm-water sewers, and the city engineer deems that but few more are necessary. Mr. Moore cites complaints from other city officials to show that this sewerage is very inadequate, but it seems that this is partly from the imperfect character of the sewers as well as the small amount. No advocate of the separate system would expect to provide storm-water sewerage at so small a rate as a mile to 30,000 inhabitants. To reach all the lots in an average city as is needed for domestic service, needs practically about the same amount of sewers as of water or gas mains, averaging perhaps about a mile to each 1,000 inhabitants—less in densely populated districts, more in those of less density.

This city, as stated by Mr. Chanute, from its peculiar topography will be more like a number of small towns than one continuous city in its requirements for sewers. It follows from this that the amount of sewerage per capita will be greater than in a more regular topography, and it is correspondingly more important that the best and most economical system be devised. Mr. Chanute in this makes incidentally a strong point in that he says many engineers do not realize that storm-water sewers are not needed everywhere.

With regard to cleanliness of streets, so far as the experience of the writer extends, it bears out Mr. Chanute's claim that the best sewered cities are not the cleanest. Memphis without storm-sewers is very noticeably cleaner than this. Our clay is but partly carried into our sewers by our occasional storms, and it is very doubtful whether what is carried into them does not entail more expense than it would be to cart it off, without having to bail it out of the catch-basins.

This naturally brings us to the consideration of the value of these and the office they are supposed to perform in keeping noxious exhalations out of the streets.

In passing through different portions of the city the writer has noticed in cold weather the frosty air coming out of these catch-basins; showing that the traps had become so far emptied as to unseal them, and an average of these was found to be about four out of ten. It may be questioned whether four catch-

basins out of ten are not enough to let all the exhalations that the sewers can make escape, and whether the four persons taking these in, would not rather the other six should share with them; in such things we are often very unselfish.

With regard to the noxious character of these exhalations both writers and smellers are divided; all, however, agree in not calling for more.

The quicker sewage can be disposed of, the less will it affect the public. The small sewers do this, for their smaller size gives a quicker flow and leaves less margin for the accumulation of material to decompose. When the sewage has acquired considerable volume it will be less liable to such accumulation in large sewers, and accordingly the use of the combined system will be less objectionable the nearer we approach the outlet.

This leads to a consideration of cost and size. The combined system of sewerage has cost an average per mile of $30,146 in St. Louis, $25,000 in Brooklyn, $34,550 in Providence, $20,727 in this city. The separate system has cost in Memphis $6,875 per mile. An estimate for the city of Baltimore gives $10,000 per mile. In Leavenworth the work so far has cost about $8,800 per mile, including the main trunk sewer. This will be reduced by the extension of laterals, which cost an average of about $6,000 per mile, including flush-tanks and royalty. Such data are modified by local circumstances. It occurs in most cities that natural water courses are closed in, and while they greatly increase the cost of sewerage, they give value to the ground with which the sewer is not credited; it also occurs that large sewers are built to form trunks for future extensions, the result of which when made would be to reduce the average cost materially. It would be a fairer exhibit of comparative cost to compare the systems simply by the actual cost of the sizes of sewers required for each.

In considering this, but little stress has been given to the difference in rainfall in different localities. In England, where the combined system may be considered as having its best growth, rains are frequent and the storms comparatively light; in London the record of three years showed 746 rainy days, and on only four days did rain fall to the depth of one inch in twenty-four hours. Here we have months at a time without rain, and then storms of great severity;—as much as three inches of rain having fallen in one hour, and a rainfall of two inches or more per hour being so frequent that it is necessary to take cognizance of it in our sewer construction.

The sewerage of Brooklyn during its heaviest flow is estimated at one one-hundredth of an inch per hour for the whole area of the city. In fourteen years the record shows ten storms of one-half inch per hour, and ten more between that and two inches, one of over two inches, and one of over three inches.

An usual practice in American cities has been to provide for the sewers carrying one-half inch per hour, and the few storms giving more than this amount to the sewers would seem to justify that provision.

Late experience in Brooklyn and other eastern cities, however, shows that this is inadequate, and the result of heavy storms has been the flooding of low

areas with the sewage from higher ground to such an extent as to cause serious damage to, and depreciation in the value of property so situated.

Some of the more recent sewerage work in the East has provided for the admission of one inch of rain per hour to the sewers, and if we would avoid damage to property, for which the city may become responsible, it will be necessary to make even greater provision than that; in fact, some of our storms carry water to the sewers at the rate of fully two inches per hour, or two hundred times the amount of the heaviest sewerage proper. With regard to the amount of storm-water sewerage required it will vary greatly in different localities, being the greatest in the low lying lands where it is necessary on account of slight grades to have larger sewers and carry them nearer to the margin of the watershed.

An area of some two hundred acres in the low land of West Kansas City has two sewers, measuring with their branches, some 11,000 feet, draining some 300 lots and leaving some 700 to be yet provided for, which would increase the sewerage in this district to some 20,000 feet, of which about 5,000 feet is necessary as storm-water sewer.

In a district of some 140 acres, partly drained by the Broadway sewer, there are now some 18,000 feet of sewerage, draining some 400 lots, and leaving some 200 yet to be provided for; the amount of storm-water sewerage required in this district is about one-fifth of the whole.

These areas are perhaps as different from each other as any in the city, and indicate that of all the sewerage required, from one-fourth to one-fifth may be considered as necessary for storm-water, and that the remaining three-fourths or four-fifths may be built on such plans as may be considered best.

These storm-water sewers being in the lower part of the district, it would be most natural to consider them as the trunks of the sewer system, and the advocates of the combined system can find good reasons for claiming that they should be so used; if used to this comparatively small extent their size can be afforded ample for full efficiency, and the other sewers using them for an outlet would help to keep them so clear that they will be as inoffensive as such sewers can well be made.

This would give the remainder of the area to the separate system, avoid the objection of building duplicate sewers, make an unquestionable economy, and perhaps reconcile the views of the advocates of the different systems as nearly as it can be expected that they will be.

As an example illustrating this proposition we will assume an area of 300 acres in which no sewers are yet built, and that to reach all the property in the district will require six miles of sewers of which one and one-half are needed for storm-water.

One and one-half miles of storm-water sewers .	$ 36,000
Four and one-half miles of small sewers	26,000
Total	62,000
Against six miles of combined sewers	120,000

ying nearly one-half of the whole expense, and very great modifications of ese data will be needed to prevent a large economy from being realized.

SOCIOLOGY.

SOCIAL SCIENCE IN KANSAS CITY.

The Social Science Club of Kansas and Western Missouri met in this city on ay 9th and 10th. There were 109 members present, the various cities of this cinity being represented as follows: Leavenworth twenty-eight, Kansas City enty-five, Wyandotte nineteen, Topeka sixteen, Lawrence twelve, Atchison ne.

The reception committee consisted of Mrs. E. H. Allen, Mrs. Kersey oates, Mrs. P. D. Ridenour, Mrs. H. W. Baker, Mrs. Wood, Mrs. T. H. Ken-dy and Mrs. J. C. Horton. Mrs. Coates delivered an appropriate address of elcome, which was responded to by Mrs. Geo. A. Banks of Lawrence. The nual address was delivered by Mrs. C. H. Cushing, President of the club, after hich papers were read by Mrs. Elizabeth Mayo of Leavenworth on "Water as Cinder, a Solvent and a Healer," followed by a general discussion; Mrs. T. M. ennedy of Kansas City upon "The Ice Age;" a poem of greeting by Mrs. Dav- Patton of Atchison; "Living Issues in Social Science," by Miss E. P. New-mb of Kansas City; "Education outside the School Room," by Mrs. Dr. W. nes of Sedalia, Mo.; "Character a Growth," by Mrs. H. E. Monroe of Atchi-n; "Culture for Women," by Mrs. S. M. Ford of this city; "Entertaining," iss Lula Dunn of Lawrence, "Physical Education of Women," Dr. F. M. W. ckson of Emporia; "Mendelssohn," Mrs. C. F. Runcie; "Divorce, Its Results Women;" Mrs. Ella H. Kingsley of Paola. All of these papers were of a high der of style, ability and appropriateness, and should be published in permanent rm. We select as a fair sample of the whole the following paper by Mrs. Dr. m. Jones, of Sedalia, upon

"EDUCATION OUTSIDE THE SCHOOL ROOM:"

It was Edmund Burke that said "Education is the cheap defense of nations," nd perhaps we cannot find any one who does not recognize the fact that educa-ion in the broadest sense of the term, both in the common school and in the igher realm of culture, is essential to the maintenance of an advanced civiliza-ion and requisite to the intellectual and moral progress of the race. No thought-ul person can doubt the fact that the best arrangement of public affairs, the high-st attainment of moral culture and the purest state of social life are dependent pon the thoroughness and universatility of education. The beneficent Creator as bestowed on man mental and moral faculties. He has graciously endowed

him with social qualities which may be trained to grand and noble purposes. Reason and revelation enjoin upon man the obligation to cultivate for noble uses these God-given powers. The capacity developed and the direction given to these is what is implied by the term education. But it is true that much the largest proportion of mental and moral training received by each member of society comes through exterior channels. Man is unconsciously educated by that which is daily transpiring around him. As the rocks and pebbles polish each other by contact in the flood, so men affect each other, and character is moulded by personal influence in the rushing tide of life. Coming within the circle of these ever operative forces, we see that the process of training that we call education goes forward much more rapidly out of school than under the care of the professor. Prominent among the agencies that make up the sum total of the educating forces is the social influence of the home. As a rule the life receives its outline and general direction before the pupil enters the public school. Education begins with life. The sense of touch first ministers to the infantile training; afterward the sight, then the hearing. The senses are the guides leading the van in the progress of nature. We necessarily begin with present and tangible things. Afterward we give absent things a visible form by picture, and this meeting the eye, is described and impresses the mind through the sense of hearing. Thus, before we are conscious that the child is affected by surroundings, the foundations of character are laid.

"The real seed corn whence our republic sprung was the Christian households which stepped forth from the cabin of the Mayflower, or which set up the family altar of the Hollander and the Huguenot on Manhattan Island or in the sunny south." The best characters, the best legislation, the best institutions were cradled in such homes. Immediately in connection with the home are other social influences that operate continuously as teachers. There are groups of children in the alleys and on the commons, the natural product of the saloons, a vicious and neglected element, being educated rapidly for evil. In a few years they will control the elections and re-enact the shameful scenes so recently perpetrated in Cincinnati.

The religious and secular press are agencies of great power, wielding a mightier influence on the public conscience and the character than the schools. The poet Browning says:

> "But mightiest of the mighty means
> On which the arm of progress leans,
> Man's noblest mission to advance,
> His woes assuage, his weal enhance,
> His rights enforce, his wrongs redresss,
> Mightiest of mighty is the press."

How shall we speak of this enginery for good or evil, this resistless force that day and night moves on with ever increasing power, enlarging its sphere and intensifying its importance as an educator? Through the press religion, liberty and law are made effective in fitting men for noble deeds. But by the same

agency, plagues worse than those that destroyed the land of the Pharaohs are diffused over society, poisoning the pure fountain of public and private virtue. Cowper says:

> "Thou fountain at which drink the good and wise,
> Thou ever bubbling spring of endless lies,
> Like Eden's dread probation tree,
> Knowledge of good and evil comes from thee."

War and commerce are educating forces, and although intimately related, each has its distinctive features. The varied lessons of war cannot be analyzed, the subtle influence cannot be measured; it is beyond the reach of all chemical solvents known to the world; it breaks up all existing forms of thought and compels society to take on new ideas and clothe itself in new attire. War does not always educate aright, When its power is sought for perpetuating despotism, for oppressing the toiling millions of earth, it awakens no holy aspirations; it develops the lowest and darkest passion of the soul; it puts out the light of home, and settles like the shadows of death upon the crushed and blighted sons of men. But when war is necessary for the purpose of guarding freedom's holy altars and defending the honor of home and preserving beneficent institutions for those who shall live in coming years, it takes on a brighter hue and its educational powers are exerted along other lines; if it inaugurates political convulsions, these, like geological upheavals, usher in new epochs in the world's history that indicate its rapid growth, for the public mind that is indifferent to the arguments of a statesman is educated quickly and thoroughly by the events that are the sequences of a defensive war.

So far as we can judge from the view we can get of the subject, the Divine mind contemplated this earth as the sphere of man's noblest activities, and in providing for his progress, for the discipline of his moral faculties and for his intellectual nature, He so constructed the earth that commerce should become a science, and, that while it should administer to man's physical wants, it should at the same time contribute to the adornment and development of his mental and moral being. In order that man might not fail of this, He distributed with a lavish hand the gold and silver in the crevices of the mountains. He set the sturdy oak and the pine in the Northern forests. He gave the cotton and the corn to the rich valleys of the South and West. He filled the caverns or the earth with coal and oil, and deposited the pearls and gems in the depth of the sea. So, that while in every land there are the staples and the luxuries, an exchange of commodities is a necessity, and while the American fills his home with the productions of foreign lands, the streets of the cities of ancient learning and wealth are lighted from the oil wells of his native land. The desire for wealth has always been a spur to human exertion and the possession of wealth has been and ever must be a source of power to the individual and the state. Gold is the sinews of war and the amount of gold possessed by any nation is the measure of its

material value. Before the rise of commerce the only intercourse nations held with each other was that of warfare.

"There were then only two sources of wealth, agriculture and pillage." "Cyrus led the Persian armies to the rich provinces of Asia for the express purpose of plunder." "The Romans who were then masters of the world arrogated to themselves all treasures." Having heard of the fabulous riches of one of the kings of Egypt, "they passed a law by which they constituted themselves the heirs of a living monarch and confiscated the dominion of an ally." Such was the state of the world when commerce began its career. It entered the arena as an educator, it laid its fashioning hand on every department of life, it transformed hostile nations into admiring and devoted friends and bound them together in their efforts to subdue the earth and make it yield up its treasures to the will of man. Although it did not abolish war, it showed the highway to the golden age by developing new industries and making attractive and possible the arts of peace. Commerce began to manifest its powers a thousand years before the Christian era. It originated among the Phœnicians and, although subjected to many adverse influences and suffering many reverses, it has steadily gained in extent, power and influence, and at the present time it is in a great measure shaping the policy of all nations and projecting enterprises which cheer the hearts and brighten the homes of millions of the human race.

But there are two prime factors in the education of the masses, two agencies that in a larger and more general sense contribute to the education outside of the school room; the lecture platform and the pulpit. These are educating forces in the strictest sense of the term. The lecture platform of this age is a modification of the ancient forum. The orators of Rome and Greece were the educators of the people. But the form of society in which we live gives to the platform a wide range and more extended influence.

Committees on special subjects, boards of health, trustees of benevolent institutions, legislative bodies, and almost every conceivable variety of deliberative assemblies meet and discuss questions of commerce, education, social reform and political economy, and while this form of society remains, the lecture platform must always be an agency for the instruction of the people, voicing alike the grandest thought of the scientific man and the orator who directs the thought of the common citizen in the ordinary affairs of life. While the pulpit does not cover so wide a range of topics as the platform, is not possessed of the almost limitless variety, it is more forceful, in manner more definite and impressive than any other method of instruction. From the days when Ezra, the scribe, "stood upon a pulpit of wood and read the law" to the present time, the pulpit has been a definite and authoritative means of instruction. It is not an institution which may lose its influence in the lapse of years. Since the days of Jesus the forums of Greece and Rome have perished or have been superseded by the modern lecture platform, while the pulpit has multiplied itself and more nearly controls the public conscience than any single influence, and perhaps excels all other agencies outside the schools.

But in this brief estimate of educating forces we cannot overlook the exalted and refining power of music and art, nor reject their contributions to the culture and happiness of the human race.

The meaning of song goes deep into the heart. No one can express in a logical form the effect music has on man. It is a form of unfathomable speech, warming the soul for heroic deeds. According to a fable, Orpheus was presented with a lyre by his father, who taught him to play upon it. He attained such a skill that nothing could withstand the charm of his music. Men and wild animals thronged round him entranced, the trees crowded about him and the rocks softened under the magic of his notes. His wife dying, he followed her into the realms of Pluto and there sang his woes so pathetically that the ghosts wept. Tantalus forgot his thirst, the fairies shed tears and Pluto consented to restore his lost wife.

However much of fancy there may be in this, music forms the universal language which, when all other tongues were confounded, was left unchanged amid the babbling multitude. All nations can sing together when they cannot understand each other so as to converse. Music is the inarticulate speech of the heart, and cannot be compressed into words, because it is infinite. And this universal teacher teaches kings and peasant, and puts its polishing hand upon the farmer's son and the statesman. It is our inspiration to patriotism, philanthropy and religion, an agent more effectual than the instruction of the professor, in shaping the character and destiny of nations and men.

Intimately related to music is art, a wonderful teacher; also a perpetual force in character building, an inspiration to the student to seek a more intimate acquaintance with his own powers. "Art is the enduring record of man's purest conceptions in tones universally and forever intelligible."

However broad the scholarship, art improves the taste, refines and polishes the manners, and gives the luster and brilliancy to all other attainments. Art establishes a holy communion between man and nature. Ruskin says: "Man is not a child of nature like a hare. That nature is worse to man than a stepmother, persecuting him to the death if he does not return to the realm of art where he belongs." The gallery of art runs back through the ages of the world's life, and has gathered the finest conceptions of the finite mind. Within the golden gates of this temple the canvas and the stone are full of vitality and intense with expression. Along the polished walls of this temple are hung the masterpieces of the great artists. Along its lengthened corridors architecture has inscribed her name and lent her loveliness for its pillar and canopy. In her gorgeous aisles the sculptured marble stands radiant with grace and beauty, and from the canvas and the stone the mind catches the divine outline, the fair ideal of a perfect life. The productions of pencil, brush and chisel, the frescoes, the carved work and painting of the ancient temple and modern gallery are the silent teachers of the coming ages, the high ideals toward which each new generation aspires.

EDUCATION.

COMMENCEMENT AT THE KANSAS UNIVERSITY.

Among the numerous exercises and addresses at Lawrence during commencement week, none seemed to make a more profound impression than the address of President John Bascom, LL. D., of the University of Wisconsin before the literary societies, on the evening of June 2d, upon the subject:

"WHAT THE MEMBERS OF A STATE UNIVERSITY OWE TO THE STATE."

Dr. Bascom spoke for an hour and a half on this subject and during the entire time held the rapt attention of his audience, great thoughts seeming to start out from every word. The following imperfect synopsis of the lecture gives but a faint idea of the great strength and character of the discourse:

"The American people are a practical people. They do things well. Our danger lies where our power lies. The workers have the highway and they who do not belong to this class must look out for themselves. The American proverb is "Look out for no one." The practical and theoretical belong practically to the same thing. We are to remember that the present is for the future and the future grows out of the present. The theorist may be full of ideas, but loses their use. The statesman is both a theorist and a practical man. The American is never afraid to have a tilt with political science. He never wakes up until immediately confronted by great danger. We were thus confronted with the rebellion. Theory and practice when each is true to itself must meet at some time. The man of theories and book learning must not be avoided. He has that which we must outlive, but through which we must pass. The subject of the lecture is "What do the members of a State university owe to the State?" Justice and claims are commensurable. Justice is rooted in the right of men to command me. Benevolence is the right or power to control myself. "What do we, as men, owe to men?" You of the university owe gratitude to the State for the great advantages of education. It is wrong for one worthless man to lean on the man of a useful and prosperous life. The State by its just sense of generosity gives it to you for the advancement of the best interests of the public. There is no broader obligation than that under which the State has laid you by its action. The higher institution must care for the lower ones. If the limbs and trunk of a tree be lopped off the roots will perish. Our university should be supported by all the lower institutions of education and protect them as well. A higher education is too little cared for in our country. The State may educate because it can educate, and because it is beneficial to its citizens. We do not fall into such errors when other things are in danger. As to his property when this is the case, he is

only too ready to conscript his neighbor as a recruit to the army to protect his property. Education should be free and full and humanitarian. That is a disagreeable one who is a man of mere practicality. Take care of that man and the man will take care of himself, and if there is anything worth doing he will see it and do it. To save only that we may save more is true conservatism. To move foward, to grow, is the true course. The second duty you owe to the State is to stand with it and for it. It is the duty of the educated to winnow the wheat and to let none but the good seed go back to the soil. Politics is a sin against the soundness and integrity of human speech. It is an illustration of the saying "every fellow for himself and the devil take the hindmost." The accumulation of great wealth in a short time is an appropriation of the public finances, brought about by the peculiar state of our institutions, and he who accumulates does not render commensurate service. The common welfare is to be the dominant idea, but it is not now the fact with us. The query ought to be, "Who ought to be made to pay taxes?" not as it is now, "Who can be made to pay the taxes?" "Vanderbilt and Gould have been more successful, not more selfish. But this power of great accumulation should he made impossible. True liberty stands for productive power. The sale of intoxicating drinks undermines more of the liberties, hopes and happiness of the people than almost anything else."

The speaker then turned his attention for a few moments to the press, and his words are given verbatim: "Never has the public press been so active, so influential as now. Yet its abuse of power in this country passes all estimate. It substitutes enterprise in gathering and circulating news for real intelligence, and puts smartness of repartee in place of sound principle. Its destructive characteristic is mendacious personality. Let every man for himself modify this statement, general in character, by the exceptions which it calls for, yet these being made how many papers among the thousands of papers in our land would any one of us be willing to bring forward and present to a high minded, fair minded, but thorough critic as good types of wise, able and beneficial journalism. The moment an item of interest finds its way into a journal it flies all over the states with only the slightest attention to its truth, or to the injury it is likely to do. One might as well ask the winds that fling dust in his eyes in the street to be a little more considerate, as to ask our daily press, rushing through every highway and byway like a whirlwind, to be more careful in sweeping upward and onward the perversions and misrepresentations that choke the air; it ought at least to check our omnivorous appetite for news to reflect that if we include minor errors in detail and false coloring, the larger part of what we call news is false, is often moral malaria scattered from the festering centers of human life. True, well ordered responsible journalism, a medium of clear, sound and efficient ideas, is still a dreamed-of blessing, that approaches but slowly and from a great distance. Here also, young men and young women, you should carry correction to this eager, succulent, evanescent journalism, of which we have so long had our fill. Law is is tempered with too much chicanery and needs the refreshing influence of new blood."

The philistinism of American society was briefly and pointedly treated by the doctor with his sharp, caustic language, cutting sharply and mercilessly the weak points in our artificial society. At this point Dr. Bascom paid his respects to Chicago in this manner: "The visit of Matthew Arnold has brought the tendency of philistinism of American society clearly to our minds. It is hard for a man to apreciate a man like Matthew Arnold; hard for them to make the allowances this great critic calls for, hard for them to relish and digest the truths he offers. This was very distincly seen a short time since in the action of Chicago. The mere shadow of Arnold fell on its streets and every dog, big and little, rushed before the public and emptied his canine impatience and petulance into the air. Lo the shadow proved to be not even a shadow, but a stuffed image, donated on fool's day by the more tranquil and self contained city of New York. The weary dogs had nothing to do but to retire, each to his own yard and meditate on the surprisingly illusory character of the world and the things in it. It is said that irritability under criticism is a promising sign. If so there is a good deal of promise to Chicago. It is not easy to justly estimate so typical and prodigious a piece of Americanism as is Chicago, so full of open and latent evil, so rich in the possibilities of good. One thinks of the chant of the three witches, and these three witches were avarice, appetite and vain show.

"Double, double, toil and trouble,
Fire burn and cauldron bubble."

The address was one of the most able ever heard in the University hall. The members of the societies congratulate themselves on their success in securing so excellent a lecturer as President Bascom.—*Cor. Kansas City Journal.*

COMMENCEMENT AT WASHBURN COLLEGE, TOPEKA, KANSAS.

"THE FANATIC."[1]

Of late the public thought has been turned to consider the lives of men who in their day were held by very many to be wild visionaries. For fifty years Wendell Phillips was contemned by a large body of his countrymen as an erratic, unbalanced teacher of ultra views, while the name of John Brown flamed luridly on the sky as a fanatic.

No age conspicuous for daring innovation, for profound upheavals of established order, for heroic advancement, has been wanting in men whose voices rose shrill and clear above the confused din of every-day life, proclaiming like rapt prophets theories and demands which sounded in the ears of their contemporaries as babel cries of men bereft of reason. In periods of great civic distress or peril warnings have rung in the air from seers believed to be pale with frenzy or deluded with bewildering fantasy. With what derision did the priests of Baal and Ashtaroth look upon the grim and hoary prophet challenging them on

1 An address by Judge Solon O. Thacher.

Carmel's height to mortal combat, and to determine by the lightning of the skies which worshiped the true God. Hebrew history in all its course lifts on high these weird characters, separated from all their surroundings by claims and pretensions denied or scouted by men of their own time. Their foreboding and entreaty were alike unavailing, since they were received as coming from men moved by disturbed and unhinged minds.

Emerson, I think it is, says that the heresy of yesterday becomes the literature of to-day. When too late the awakened Trojans recalled the wild prophecies of the frenzied Cassandra. Because a man's neighbors call him an enthusiast or a fanatic, a benefactor or a demon, it does not follow that he is such. When the man's picture is finally placed in the long gallery of time, the mellow historic light falling upon it at a proper angle, then we can say whether it is the face of a malevolent zealot or of a devoted lover of his race. The veiled prophet of Khorassan, sneering at the delusion of his followers, we know was a fiend behind his snowy robe and shining visor:

> "So shall they build me altars in their zeal,
> Where knaves shall minister and fools shall kneel;
> Where Faith may mutter o'er her mystic spell,
> Written in blood—and bigotry may swell
> The sail he spreads for heaven with blasts from hell."

There are conceptions of good or evil in some natures that so outrun their age that the mass of people, unable to rise to their summit or sink to their depth, pronounce the proclaimer thereof a fanatic. Then, again, it happens that a man's contemporaries may have full faith in his power and seership, and blindly follow his impassioned voice, but a later and calmer age beholds in him only a fanatic. The Crusades, whose gigantic movements not only convulsed the world, but whose disasters and ignominious failure at the last wrought out for civilization and the emancipation of thought the most stupendous results, so far as Peter, the hermit, is concerned, were the product of a strange and misguided religious frenzy. Yet to monarch and peasant, to warriors and children, to thoughtful monk and chivalric cavalier, he seemed to preach a duty and a pleasure, enjoined by the holiest of sentiments.

> "Great wits to madness are near allied,
> And thin partitions do their bounds divide."

If, however, we more attentively consider the modern use of the name, "fanatic," we find that it has been so played upon by the valiant and radiant lives of so many heroes who have been proud to wear the despised appellation, that much of its olden dismal features have faded into lines of awe and beauty. The fortune of other odious and dishonoring designations in becoming transformed into names of honor and worth, has in some degree fallen upon this word, which once condensed into itself ignorance, fatality and superstition. The men who have gloried in being stigmatized as fanatics, who have been serene amid ostra-

cism and persecution, who have been lifted high above storm and cloud by the faith that inspired them, and who have left names

> "At whose sight all the stars
> Hide their diminished heads."

possessed some general qualities worth our while to note. They were men of genius rather than men of talent.

Of all the distinctions I have seen drawn between genius and talent, I prefer that of De Quincey. In his essay on Keats he thus distinguishes: "Genius is that mode of intellectual power which moves in alliance with the genial nature, that is with the capacities of pleasure and pain, whereas talent has no vestige of such alliance. Genius is the language which interprets the synthesis of the human spirit with the human intellects, each acting through the other, while talent speaks only from the insulated intellect. And hence also, it is that besides its relation to enjoyment and suffering, genius always implies a deeper relation to virtue and vice; whereas talent has no shadow of a relation to moral qualities, any more than it has to vital sensibilities. A man of the highest talent is often obtuse and below the ordinary standard of men in his feelings; but no man of genius can unyoke himself from the society of moral perceptions that are brighter and sensibilities that are more tremulous than those of men in general."

Another writer condenses the argument in these words: "Nature is the master of talent; genius is the master of nature."

I speak now only of the fanatic whose genius allied him to human welfare and ennoblement. Many men have gone singing to the pyre for conscience sake, many have passed into the whelming waves of persecution, obloquy and death for a fanatical faith; exile has borne into the snows of Siberia true hearted men who cherished thoughts hostile to despotic sway; and in all ages clans, tribes and whole peoples have suffered the loss of home, substance, and even life, for fidelity to beliefs called by their destroyers fanatical—all these, indeed, bear "a good report" amid the voices of history, and their loyalty to conviction remains a range of lighted headlands along the coast of time; they are a part of that universal teacher we call human experience. But now and then among these unsung and inconspicuous martyrs there rises a majestic form, an awful presence, which rivets our gaze and concentrates our wonder. He heralds a mighty epoch —he embodies the aspirations of the unknown and nameless multitudes. The sorrows of his dumb and stricken fellows have touched his soul to a tension and exaltation only possible to a few. Of self he has no care; the planning and plotting, the vacillation and deviousness of the man of mere talent governed only by ambition, have no dominion over him. He follows, as only a man of genius can, an ideal immeasurably above his day; he pursues through defeat and shame a bright and, to him, ever alluring hope whose ultimate realization he undoubtedly cherishes, and whose consummation he devoutly trusts will bring happiness to mankind.

Back of deeds lie thoughts, and beyond thoughts are feelings, emotions.

Knowledge is a bleak, dark shadow against the upper air until there rises above its crest the fiery column of the glowing lava and the flame-lit vapors of intense emotion. When out-reaching thought is vivified and illumined by a profound belief in the imminence and guidance of supernatural control, at once there moves into historic light and grandeur a central figure, and often a fanatic whose record is the story of his age.

Who could bring before us Athens without recounting the marvelous life and philosophy, the gracious yet despised teaching of Socrates. He drank the fatal cup of hemlock because beyond his day he beheld a more perfect way of life for the Athenian youth than the chosen beliefs and rites of their ancestors. Gibbon, cold and agnostic, cannot touch a single phase of that vast empire, whose decline and fall he so majestically recites, without, amid all his cynicism and unbelief, halting spellbound and amazed, to wonder at the inexplicable hold possessed by the life and words of the humble Nazarene, dying in obloquy an abhorred death, over the legions of Cæsar, the favorites of the royal palace, the students of the colleges, and the hordes swarming from Northern woods and snows over the plains of the Po, Adige and Tiber.

The most illustrious character in all history, save one, is that citizen of Tarsus who, standing with clanking chain before imperial rulers, clad in gold and purple, pleaded for the acceptance of an obscure faith, whose outcome would immeasureably bless the world, with such pathos and intellectual power that he seemed to one governor a madman and to the other the revelator of a divine religion. The widest acquirements of wisdom and philosophy of that day were found among the porches of the academies and the groves of scholars in Athens, that city of ancient art and wealth. Standing in the shadow of that temple of Minerva, whose statue, frieze and decorations were the work of Phidias, Paul delivered a plea for Monotheism and its great human representative which, even in its fragmentary form, has excited the wonder of the orator, the imagination of the poet, and the homage of the believer. In the annals of time there is no more impressive illustration of the majestic bravery of transcendent genius than this contemned Hebrew from the rostrum where Pericles had spoken, philosophers argued, and bards chanted sweetest lays, proclaiming to learned and acute professors, teachers and logicians, his unshaken faith in the resurrection of the dead, and leading his auditors up to this new and strange doctrine by irresistible appeals to the vague yearnings of their own poets and the mute sentiments of their own altar builders. Or, if there be a more marvelous scene, it is this same man at a later day, pale with prison damps and darkness, with manacled limbs, unmoved by a double court and royalty, recounting before Festus and Agrippa and Queen Bernice, the noonday light that bewildered him as he rode along the mountain crest above the white spires of Damascus, the heavenly vision he there beheld, and the divine mission then given him, which ever after was to master and impel his life. And yet, doubtless, the large majority of the men whom Paul addressed at Jerusalem, or in the cities of the Mediterranean and at Rome, as they turned away from his fervid utterances, exclaimed, What a gifted, learned fanatic! The

creed he then proclaimed, so visionary and fanciful to that generation, is to-day the cherished hope of the world.

A further analysis of the fanaticism that has happily affected human destiny, reveals the quality of resolute tenacity. In all the realm of action what victories have followed the man who knew how to cling to his purpose! What obstacles have yielded to his defiant will? "There is no difficulty to him that wills." Repulse gives him strength. Advance tightens his lips. The unexpected finds him prepared. Over the disaster he flies the banner of hope. Beyond the hour, whether it be cruel with tempests or flaming with light, he beholds enthroned the object of his desires, and toward it he presses with unswerving resolution.

The dreamer of Bedford jail saw poor Pilgrim diverted from his noble path by a pleasant arbor on the slope of an arduous hill, and all along his journey images of delight and visages of despair intimidated or allured him. Not as the man whose life when spent passes from an erratic and meteoric course into the steady and benign radiance of a fixed star. The good he would do, the benevolence he would create, so absorbed and overpowered all other tendencies that temptation rarely assailed and never overcame his dominant desire.

Longfellow exclaims:

> "O, Palissy, within thy breast
> Burned the hot fever of unrest;
> Thine was the prophet's vision, thine
> The exultation, the divine
> Insanity of noble minds
> That never falters nor abates,
> But labors and endures and waits,
> Till all it hath forseen it finds,
> Or what it cannot find, creates."

Genius without this "tendency to persevere" is certain to fail. It runs well for a season, but anon it falls out by the way.

The man who never forgets a benefit, how he is loved! The most ignoble mind admires fidelity—friendship. The world pays homage to the man who clings to a friend. It despises him who measures his action to another by the sordid reflection, "How will this affect my future?" He who profits by another's baseness, yet mutters to himself the old saying' "I love the treason, I loathe the traitor." There are no passages in history so repulsive as those which bring before us the betrayal of a friend or patron by the ambitious or insincere man. The "Art thou in health, my brother," of Joab, the dagger of Brutus, the kiss of Judas, the gilded treachery of Marlborough, the unholy revenge of Arnold, with what aversion does the historian and poet dwell upon them.

This quality of endurance illumines the good cause with radiance, and even when it touches a bad one it evokes a degree of wonder. Such is the effect of the picture Milton limns of Satan drawing himself above the fiery billows and resting his "unblest feet" on land that ever "burned with solid fire," there to

resume his eternal war and strife with Omnipotence. He who is true to a friend or a noble principle—who never swerves when the hour is darkest, but out of trouble and impending disaster gathers new hope and energy, inspired as it were to fresh acts of devotion and valor, gains universal plaudits. No man would deliberately prefer wealth or fame to the joy and peace of constant, long-enduring friends, for the one may take to itself the wings of the morning and fly away, and the other is that which a breath has made and a breath can destroy, but a true friend draws nearer to you as your eyes are blinded by the blasts of misfortune, and his constancy and cheer increase with the depth of your need or sorrow. And this same element of persistence adds intensity and horror to enmity.

The man in whose bosom there is no sunshine, but who dwells with relentless broodings over his revenge, and follows without a shadow of tiring his bitter resolve, fills us with nameless terror. The man who never forgives an injury, how he is dreaded! Out of this tenacity of purpose all the world's heroic deeds have sprung, and the want of it has brought to nothing magnificent conceptions and boundless hopes.

Historians debate about the integrity and the aim of that impressive man whose history tells that of his age, Cromwell, but none disparage the resolute purpose with which he drilled undisciplined plowmen until they were able at Marston Moor to shatter the brilliant squadrons of Rupert, and which at last placed the farmer of Huntingdon on the throne of England and made his voice a terror in the secret council chambers of royalty from Madrid to Moscow. When the poet tells us:

> "Some men are born great, some achieve greatness,
> And some have greatness thrust upon them,"

he must mean to describe mere station, position, or rank, and not nobility of soul, inherent greatness, for that alone is achieved, never inherited or received as a guerdon or reward. It has never been found disassociated from invincible purpose. Whether we search the tumultuous and stormy field of action or inspect the sequestered vale of life, wherever we see a man to whose accomplishments our souls pay the homage due greatness, we there behold one whose nature contained the fibre of unrelenting purpose.

What mountains are laid low, what valleys are raised, what crooked places are made straight to make a highway for the feet of the man of inflexible will? Of Cæsar it was said by Cicero: "Quod vult, valde vult," what he willed, he greatly willed. Whoever wills greatly stirs the world's destiny, but whether for good or ill depends finally on the ideal he follows, the motive that impels him. This it is that illumines and tranforms genius and resolution into immortal action. The more exalted the inspiration the more visionary the man often appears to his compeers.

It may be true, as Emerson says: "Nature never sends a great man into the planet without confiding the secret to another soul," for there is a kinship

among royal minds: but compared to the populace the members of the royal family are few. The man of lofty aims is thus described by Meredith:

> "The man is great and he alone,
> Who serves a greatness not his own,
> For neither praise nor pelf;
> Content to know and be unknown;
> Whole in himself."

It is quite the thing, nowadays, among certain men of brilliance to decry the influence of the supernatural either in the past or in the present. But did ever a man make a deep impress in the historic page who wàs not filled with the thought of his own subordination to superior power?

Socrates felt the monitions of an inner voice he could not disobey. Mahomet listened to a mysterious influence he called destiny. Cromwell believed that his life wás under the irresistible impulse of the Divine Spirit. Napoleon thought of a fateful star that stood over his cradle and had followed his course ever since. Von Moltke said that at the battle of Mars Le Tour defeat was changed to glorious victory by an unbidden breath blowing the silver trumpet which sounded the command to charge to the royal guard. The Maid of Orleans heard heavenly voices, amid the forests and field of Domremy, bidding her lead the armies of France until the rightful king should secure the consecrated crown at Rheims. The sacred retreat of Valley Forge witnessed the prayers of Washington. In the darkest hours of the Republic a divine light streamed into the closet of the long-suffering Lincoln. John Brown implicitly believed he was called of God to free by forcible interposition the bondsmen of the South, and this thought guided him from the slave cabins of Missouri to the frowning arsenal of Harper's Ferry and the ghastly scaffold of Charlestown.

To-day a man of this Cromwellian mould draws the attention of the civilized world as he attempts, among the sands and torrid heats of the Upper Nile, to show the barbaric tribes and frenzied hordes the exalted justice and kindness of a Christian nation. The life of Gen. Charles Gordon is one of those strange revelations which now and then call men away from doubt and agnosticism to the verities and faiths of an old-time trust in an imminent and ever present Providence. He is a Havelock in military ability, bravery and daring, and a more than Havelock in his belief in the constant guidance of all his deeds by the Unseen Spirit. Cold, hard men look with amazement upon the inexplicable career of the man who was a hero in the Crimea, disdainful of wealth, tender of the poor, sagacious and daring in danger, and as humble and faithful to the inner light as Bunyan or Loyola. The blending of sweet and gentle charities with stern martial deeds is a rare thing in history. The power to awe men into obedience and yet to hold them by the ties of devotion, is an uncommon sight. Charles Gordon transformed Chinese rebels, subjugated by his prowess, into faithful body guards, and over Soudan he throws the protection of an intrepid soul, confident of its divine mission and inspiration. Declare as we may that the man is deluded,

that his faith is the product of a diseased, ill-balanced intellect, yet the fact remains that not a stain sullies his bright career, and that if it is a chimera, a will-o'-the wisp that draws him forward, it has led him into a life noble, self-sacrificing, glorious.

It was an old saying of Cicero's, "No man was ever great without divine inspiration." And it is beyond doubt that the purer, the more unselfish the motive actuating a man, the more heroic and worshipful his life. As that motive rises towards the supreme and infinite beneficence, the more transcendent and luminous are his deeds. As Longfellow has it: "Great men stand life solitary towers in the city of God, and secret passages running deep beneath external nature gives their thoughts intercourse with higher intelligences, which strengthens and consoles them, and of which the laborers on the suface do not even dream."

Even in the lower plane of life we look with interest on the man who dares to take a risk, and if he wins we applaud. He who risks his all on a lofty object, one which touches in some way universal humanity, one that scorns sordid results, is heedless of the clamor even of those it would ennoble, who brings to this end deathless resolve and refined powers, will leave behind him something more than footprints in the sands; the living rock bears his name carved deep and plain. No matter if his age is careless of his work, the nnfolding years are sure to build a temple to his praise. It is as Emerson says: "When a man lives with God his voice shall be as sweet as the murmur of the brook, the rustle of the corn." The true man is not swerved from his course by misinterpretation or apparent failure. He knows "if his eye is on the eternal" that the transitory and the present will by and by merge into a day of cloudless beauty.

Thirty years ago men were scorned as fanatics who spoke of a law higher than the constitution; and the multitude drowned in derisive shouts the voices of those who pleaded for universal liberty as the birthright of the human soul. To-day builds marble cenotaphs over their sunken graves and writes their words among the noblest thoughts of the great age. Now, as ever, the children of those who stoned the prophets garnish the sepulchers of those their fathers put to death. Yesterday's doubt is the belief of to-day. The world has always had men who, outrunning their own age, have left blazed trees and scratched rocks whereby the multitudes following after might find their way to happier plains and climes.

Carlyle tells us the old Northmen "thought it a shame not to die in battle; and if natural death seemed coming on, they would cut wounds in their flesh so that Odin might receive them as warriors slain." They held it to be a man's duty to be brave, to subdue fear. This, says Carlyle, is true to this hour. "A man shall and must be valiant, trusting imperturbably in the appointment and choice of the upper powers. Now and always the completeness of his victory over fear will determine how much of a man he is." The perennial fibre of the man possessed of sympathetic gifts, unflinching endurance and a high motive, makes him the embodiment of Odin's hero.

Placing his chair beside that of the Abyssinian king, Gordon was told by that

royal barbarian, "I have the power to put you to death." "Do it," replied the intrepid general, "you only do for me what my religion prevents my doing myself." Such courage, such disdain of death, awed the African potentate and compelled him to submit to the man whose faith lifted him above fear. To men of this sort the world owes its deliverance from superstition, ignorance and slavery. They have given to it liberty, equality, fraternity.

Nay more, in this vast emancipation of thought and practice, not alone those who have been endowed with genius, will and benevolence in a copious degree have had a part, but all those who have been drawn into an acceptance and obedience of the sublime teachings of these men, have given something to the grand result. Unless the multitude came out to hear him, little good would the prophet do preaching in the wilderness. The gracious voice that sounded from the mountain side or rocking boat would have died on the air had not lowly toilers of the sea caught up its hallowed words and carried them around the world. A great truth, a sublime teaching, an uplifted thought does not at once reach a dulled ear or penetrate a shadowed heart. But as it is played upon by the various engines of the mind it comes into clearer light and purity, until at last the dullest intellect recognizes its worth, even to the lowest levels of life.

Few are called to guide the world; all can follow those whose prophetic eyes have seen beyond the clouds of the morning the crimson bars behind which lies the glory which shall shine one day, "redeem the world to virtue and flood it with light." The fidelities never grow old. Change touches the theories of scince—statements of philosophy and creed gather mildew and rust, but no moth burrows in the shining robe of gratitude, and in deepest reverence and love we lay garlands on the altars of sincerity, candor and truth. But while a perennial fragrance lingers around these qualities, the unfolding years interweave them with new forms and new hopes.

Out of the depths of history there comes, now as ever, one voice clearer than all others. Every new truth which contains in itself, ever so dimly, a touch of human happiness or elevation, is "of the nature of a message from on high," and will at last be hailed as the "glad tidings of joy" to all who bear burdens or patiently hope amid mists and darkness for the dawning of another day. We should be slow to reject new views or claims, lest perchance we thereby fail to "entertain angels unawares," for who can tell whether it is not as Tennyson sings:

"And may be wildest dreams
Are the needful prelude of the truth."

WASHINGTON UNIVERSITY COMMENCEMENT.

The week commencing June 9th was given to the closing exercises of Washington University of St. Louis, Mo.[1] On Monday evening the Art School gave an exhibit of the work of the past year, including drawings from the antique both in color and black and white, drawings from the nude and draped model and geometrical drawing.

On Tuesday and Wednesday the closing exercises of the Smith Academy, the Manual Painting School and the Mary Institute were held.

The commencement of the College and Polytechnic School and the Law Department was held at Memorial Hall on the evening of Thursday, June 12th.

There were fifteen graduates, six from the College and nine from the Polytechnic School. The degrees conferred were Bachelor of Arts, four; Bachelor of Philosophy, two, Civil Engineer, four; Engineer of Mines, four; Dynamic Engineer, one.

The theses of the graduates in the professional schools were quite up to the usual standard and were devoted to the treatment of some technical problem in the different branches.

The past year has been a very successful one in the history of the University. The present Freshman class is the largest ever matriculated, and the next promises to be still larger.

During the year a Professor of Dynamic Engineering has been added to the corps of professors.

The facilities for work have likewise been greatly increased in the departments of physics, drawing, descriptive geometry and practical astronomy.

It is the aim of the University to send out good men and not many men. By lowering the standard the classes could easily be doubled or trebled. In the future this standard will be constantly advanced rather than lowered. A very determined step was made in this direction by the action of the faculty during the past year, which provides for the granting of the professional degrees only after five years of study, instead of four as has been the case heretofore.

The faculty and directors of the University expect to continue this plan of a high standard. By this means they expect to attract not the greatest number, but those who are most earnest and thorough

THE STATE NORMAL SCHOOL, EMPORIA, KANSAS.

At the State Normal School, Emporia, Kansas, Rev. Dr. Cordley delivered an able Baccalaureate sermon and Dr. Edwards, late President of the Illinois State Normal University, the annual address : subject,

1. No addresses are made at the Commencements of this institution except the orations of the students (and there is a strong disposition to cut them off), so that we must give it a somewhat different notice from the others.

"CHARACTER AS RESULTING FROM CULTURE,"

We give the following abstract of it:

This is the theme of the hour. As both the words "character" and "culture" are ordinarily used with considerable latitude, we had best begin with definitions of them. Character is the sum of the qualities which distinguish one man from another. It includes every element that enters into one's make-up. The second word will be limited to school-training, the process of acquiring knowledge.

Educational machinery abounds among us, school-houses dot the land, and schools have become the hobby of our age. What is to be the result of all this? When I view man's achievements with steam, electricity and the magnifying-glass, I am overwhelmed at the thought of his possibilities. But after all they are only instruments—good if they do good—if they add to the permanent happiness or the moral sturdiness of man. This then must be the true test of all school culture.

If you teach a fact to a child you have not only added to his knowledge but you have thrilled him with your own self, and this is by far the most lasting and important of the teacher's work. Culture is of itself a most energetic producer of character. The boy who finishes the work of a school from the primary to the college has acquired habits of industry, perseverance and self-control. The habits of mind demanded by study are all ennobling, they foster manly resolution and sturdy strength. They release the soul from the slavery of delusions that so readily take hold of ignorant minds.

Consider, for a moment, the qualities which are developed by sustained habits of study. When a young child begins the study of language the work to be done comes upon him in whelming flood; the forms of the letters, their arrangement into words, and their entirely arbitrary connection with idea present a great undertaking. The study compels a high degree of concentration. Each victory is followed by a new conflict; a line seems to stretch out further than he can see; farther, in fact, than eye hath ever seen. These conflicts and victories beget that calm patience which is the key to all true achievement, and besides patience it seems to me we may name as a distinct result the development of that cheerful courage which comes as a product of repeated conquest over difficulties. A man or boy may be afraid of something whose power he has never resisted, but no one is afraid of an enemy he has once met and beaten. He would go into such a fight with alacrity.

From this well-founded confidence comes a vast increase of strength, and many other ennobling qualities of mind are developed by the school and its processes. Industry is one, and it indirectly cultivates morality, in that it precludes immoral thoughts and tendencies by its activity. I believe that the moral stamina of the cultured man is of a sturdier, more trustworthy substance than that of the ignorant. I believe that with study comes an increase of genuine, modest self-

respect. The great idea of duty and responsibility to God should be taught, enforced and illustrated side by side with the truths of science, and there will be a mutual strengthening of the one by the other.

Another of the indirect effects of right teaching is that it strengthens the habit of seeking the truth for its own sake. In every school effort the aim is to find out what is true in the case under consideration. Absolute truth is sought to be established in every case and who can doubt that the formation of such a character is of incalculable benefit.

The qualities which we have enumerated and others which we might have enumerated, had we had time, are elements of character. They make up what is worthy in a man or woman. Whatever helps to make one patient, or industrious, or cheerful, or courageous—whatever strengthens the moral purpose, lifts the soul above the mere temporary—makes one master, not of the fleeting now, but of the on-coming duration, ennobles and dignifies humanity. And this I believe right teaching helps to accomplish.

In the process of his education the child ceases to be a plaything and comes forth a self-directive personality. He holds himself as the loyal subject of truth and duty, bound to ascertain as much truth as he can discover; bound to obey as much duty as God gives him to see, and in the end there shall appear grander beauties of soul, and divine charms of character as a fruit of this faithful training.

MUSIC AS AN EDUCATOR.

PROFESSOR F. A. JONES.

In the public school curriculum of this country music is not enumerated as an essential subject, which is the reverse in the board-schools of England, where in the various training colleges for teachers it enters as an essential subject, and there every school-teacher is required to satisfy the examiners in the first principles of music, and each college or training-school has its music instructor. The government appoints an examiner who visits the training-colleges annually for the purpose of testing the students in the music department, the present examiner being John Stainer, Esq., M. A., Mus. Doc. Oxon. Organist of St. Paul's Cathedral in the place of the late Dr. John Hullah, deceased.

If music is worth cultivating among the teachers, it is worth doing so to the best of their abilities, and what teacher can feel that he or she is fulfilling the mission allotted to them when they are unacquainted with the elementary principles of harmonic combinations; for example, a class of children are taught to sing a melody which may be defined in the widest acceptation of the word as notes in succession, such as can be produced by any single voice or instrument capable of producing but one note at a time, in contradistinction to harmony, which means notes in combination or music written vertically; but when sharps or naturals are introduced in the melody a modulation or change of key may be

induced of which the teacher may, or may not be ignorant. It may also happen that the teacher has voices in the class that are better adapted for singing second, alto, tenor or bass; then it is that the teacher's musical knowledge is brought into requisition, and he will readily be able to analyze the music, know where the modulations occur, know how produced, and also with a little careful study be able to harmonize a melody or a given bass. If true music has a moralizing tendency it cannot be over-estimated in disciplining the mind of youth, and how many persons are there, who retain until late in life the songs and verses they were wont to sing as children at school, and when the human mind is distracted from the cares of daily life and worldly amusements, it naturally lends itself to musing, and then it is that the moral influences of music and poetry are brought to bear.

A distinguished moralist has said: "To music we are indebted for one of the purest and most refined pleasures that the bounty of Heaven has permitted to cheer the heart of man. As it softly steals upon our ear, it lulls to rest all the passions that invade our bosom, arrests our roving fancy, or in louder strains excites the soul to rage. Often when wrapped in melancholy the sweet voice of music charms away our cares, and restores our drooping spirits, or awakens in us the sentiments of honour and of glory. And surely that which can assuage our griefs, pour balm into our perturbed breast, and make us forget our sorrows, is deserving of consideration, and should be made use of to glorify our beneficent Creator."

KANSAS CITY, Mo., June, 1884.

THE KANSAS CITY ACADEMY OF SCIENCE.

During the past year there have been the usual monthly meetings in the lecture season, and a number of excellent papers have been read by such gentlemen as Hon. R. T. VanHorn, E. Case, Jr., Esq., Octave Chanute, C. E., Warren Watson, Esq., and R. W. Brown, M. D., all of own city, and by Professor E. D. Cope, of Philadelphia, who kindly stopped on his way home from Mexico and favored the Academy and citizens of the city with an able and instructive lecture on his favorite subject.

All of these papers except the last named have been published in full in the REVIEW, but as the Professor spoke without notes we can only give a brief abstract of it It was delivered at the April meeting and its title was

"EVOLUTION."

The Professor was introduced by Mr. Edward H. Allen and commenced his lecture by referring to the deficient education in the biological sciences prevailing among the community, owing to their recent development and the unsatisfactory text books used for their enunciation. He said the actions of animals

were performed under influence of sensibility, as being induced by their wants, which were more or less consciously felt by them.

Then followed an interesting history of the succession of life, as displayed by the fossils discovered in rocks in the United States, of which more have been found in this country than in Europe. The variability of the different species of domesticated animals was alluded to. While the pea-fowl, guinea fowl, and the cat varied but little, the dog, pigeon, and domestic fowls were very different. This variability gave ground to the assertion that like does not always produce like. Some of the wild animals varied whereas others did not. The Professor explained that this variability above spoken of proved the change from one species to another. The variable wild species extend over a large range of country, and and if a portion of that country is submerged beneath the sea level, you destroy a certain number of variations and leave the others more distinct than they were before. The proof from fossil remains shows lines or series of forms in the successive geological periods which follow each other as though descended from one another. In that way the lines of descent of the deer, camel, horse, rhinoceros, cat, dog, beaver and other animals had been discovered in North America. The lines of the elephant, the ox, bear and hog, have not been found in this country as yet.

The question of the law of evolution is stated by Darwin to be the law of natural selection or by Spencer the "survival of the fittest," which means that of a number of varieties the one best adapted for the mode of life of the animal remained, while the less perfect ones disappeared. But this answers only part of the question, as it remains to show what was the origin of the most perfect variety, or in other words, what is the "origin of the fittest." The nearest answer that has been obtained by a study of the succession of vertebrated animals in North America, is that the best structures have been produced by the movements of the animals themselves, which cause strains, impacts and friction of the various parts of the organism which have produced changes in structure. The cause of the movements of animals is the next question for consideration. Everybody knows that animals move under the influence of conscious states, and the effect of the environment is transmitted throught the medium of consciousness or simple sensibility. It is well known, however, that the majority of the functions of animals are carried on unconsciously to the animals themselves. This is an illustration of the principle that, while all motions have to be learned in conscious states, as soon as they are learned consciousness is no longer necessary for their performance. The case is parallel to that of the human mind, which is compelled to learn lessons by conscious prócess, which, when learned, can be performed without consciousness. Such process, no doubt, involves a change in the structure of the brain, and is a process of evolution of the brain. This theory of evolution accounts for the origin of physical structures as well as of the mind, and allows the hypothesis of the existence of mind as a primitive attribute of some kind of matter, and as possibly existing in the universe wherever suitable physical basis exists or can be found.

At the conclusion of the address a vote of thanks was tendered Professor Cope, and he was requested to notify the Academy the next time he thought of passing through the city, in order that he might be invited to lecture again.

A considerable number of books and specimens in various departments of natural history have been added to the Library and Museum during the year, and if our citizens could find time to take proper interest the Academy would soon be an object of pride to all intelligent people.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Apr. 20th to 30th.	May 1st to 10th.	May 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	33.	30.	50.	. .
Max	77.	86.	86.	. .
Min. and Max	55.	58.	68.	. .
Range	44.	56.	36.	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	49 9	54.1	55.2	53.1
2 p. m.	64.6	67.3	75.6	69.2
9 p. m.	55.5	57.3	61.6	58.1
Mean	56.7	59.6	64.1	60.1
RELATIVE HUMIDITY.				
7 a. m.	. .	.80	.84	.82
2 p. m.	. .	.71	.62	.66
9 p. m		.82	.84	.83
Mean	. .	.80	.77	.77
PRESSURE AS OBSERVED.				
7 a. m.	28.899	28.927	28.916	28.914
2 p. m.	28.886	28.904	29.095	28.962
9 p. m.	28.899	28.949	28.913	28.920
Mean	28.894	28.993	28.975	28.954
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	.	. .
Total miles	4469	3796	4062	12327
CLOUDING BY TENTHS.				
7 a. m.	5.4	4.9	4.3	4.9
2 p. m.	4.7	4 7	4.0	4.5
9 p m.	4.6	4.4	5.2	4.7
RAIN.				
Inches	1.32	1.87	1.20	4.39

The spring continues cool and backward with abundance of rain. A white frost occurred May 2d, but did no damage. There is considerable complaint that cherries and other fruit have not set well, but those under observation of the writer promise fairly. There will be scarcely any peaches in this vicinity this year. The season has favored wheat, and corn, though backward, has as yet abundance of time for a fine crop, but it will be harder to subdue the weeds.

APRIL WINDS.

S. A. MAXWELL.

The following shows the average temperature at two P. M. of the April winds at this place for the five years ending 1884:

Direction.	No. Observations.	Temperature.
N.	7	43.85°
N. E.	28	50.64°
E.	15	53.66°
S. E.	14	60.50°
S.	20	63.10°
S. W.	22	68.21°
W.	21	54.95°
N. W.	22	49.50°
	Average,	55.55°

From this it will be seen that the prevailing winds for April during these years were from the Northeast, and fewest from the the North. These, however, were the coldest, as might be supposed; though the south winds were *not* the warmest, being due, no doubt, to the fact that the plains of Kansas, Indian Territory, and Texas are somewhat warmer than localities farther East over which our South winds blow. The Southwest winds were much warmer than any others. By striking an average I find that the warmest winds blow from a point nine degrees West of South; and the coldest from eleven and one-half degrees East of North. This is not true of all seasons, of course, there being little doubt that the Northwest winds are coldest in winter.

It is also interesting to notice that the range between North and South is about twenty degrees, while that between East and West is but one and one-third degrees. It is further noticeable that the West wind is nearest the general average; and the sum of the North and South divided by two gives the general average within one-half a degree.

Our Southwest breezes here in April tell us what spring weather is in Kansas and those from the Northwest are the "warmed over" blizzards of Dakota, yet the hegira from this state to the latter region is not yet checked.

MORRISON, ILLS., May 10th 1884.

SOME OLDER TORNADOES.

WARREN KNAUS.

A correspondent in No. 59 of *Science* calls attention to evidences of some unrecorded tornadoes in Pennsylvania, West Virginia, Indiana and some of the Canadian States.

As our knowledge of these storms has been acquired almost entirely from observation of their prevalence dating from the organization of the present Signal Service system, any notes touching them will, perhaps be more or less interesting even if not of any permanent value in adding to Historical Meteorology. With this object in view, I will notice somewhat briefly some early tornadoes in Ohio.

In almost any general history of this State a description of General Anthony Wayne's battle with the Indians on the Maumee river is given, and it is noted that the Indian warriors were strongly posted along one edge of a windfall, and that the trees were lying so thickly in front of them that the cavalry found it impossible to dislodge them by a direct attack, and this had to be done by the infantry. This battle, fought in August, 1794, is sometimes known as the "Battle of the Fallen Timbers," and is probably the earliest authentic known record of evidences of an eighteenth century tornado in this part of the United States.

About 1824 a tornado passed through Tuscarawas County, the general course of the storm being from southwest to northeast. Its width as indicated by the prostrate trees was from one hundred and fifty to two hundred yards. The track of this tornado was somewhat peculiar; instead of a uniform width of the dimension given above, off-shoots were thrown out at right angles having a width of some fifty yards, and a length of one hundred yards.

The tornado was of great severity, nothing being left standing, and the trees were thrown with a general inclination toward the centre of the storm track. When examined in this county no skips or breaks were found, but the track was continuous.

Another tornado of probably greater extent entered the State (Ohio) in Mercer County, passing four miles south of Fort Recovery, the scene of Gen'l St. Clair's defeat by the Miami Indians in 1791. The course of the storm was from the southwest to northeast, and it passed in this general direction near Bellefontaine and through Marion County. The width of the storm track, the direction in which the trees were lying and the lateral off-shoots, were similar in this windfall to the one described in Tuscarawas County, and was of about the same date.

About half a mile distant from the track of the above storm in Marion County, was evidence of a much more ancient tornado. The limits were not well defined, but it was supposed to have occurred about a century previous to its later and more extensive neighbor.

About 1854 the town of Monterey, in Mercer County, was damaged by one

of the these storms. While not extensive as regards the territory passed over, its force was very great. Trees that were lying half buried in the ground were torn from their resting place, and a stack of grain was strewn along the course of the tornado for a distance of three miles.

While the evidences of these old aerial disturbances are fast disappearing in those states where the forests are giving way to cultivated fields and these in turn are becoming the sites of thriving villages, the resident of thirty or forty years ago has no difficulty in recalling the broken, twisted and upturned trees that were left as mute witnesses of the fury of the elements in the unrecorded past.

On the treeless plains of the west a tornado is only evidenced by the destruction of the improvements of the settlers, and how many there were anterior to to the first inhabitants can never be known.

GREAT EARTHQUAKES.

England has had a good many earthquake shocks, but the one of April 22d seems to have been one of the most serious. In 1089 a severe earthquake shock was felt throughout England, and in 1274 the whole Island was shaken again, and the town of Glastonbury was destroyed. On the 14th of November, 1318, occurred the greatest earthquake ever known in England. There was a slight shock in London on the 19th of February, 1750, and both England and Scotland felt a slight shock at the time of the great Lisbon earthquake in June, 1755.

For nearly a hundred years after that there were no noticeable disturbances and only slight shocks in 1855, 1863, and 1868. On the evening of March 17, 1871, there was a severe shock in the northwest of England, in which houses were shaken and crockery broken. In the earthquake of April 6, 1580, part of St. Paul's and the Temple churches fell. But with this exception and the disturbances of 1274 and 1318 England has been more scared than hurt by earthquakes. Certainly that country has been as free from earthquake disasters as the United States, and probably has had no shake as severe as that in the Lower Mississippi Valley in 1811, when great chasms are reported to have opened in the earth. This preceded by a few months the upheaval at Caraccas, Venezuela, in which 12,000 people perished.

England, like the United States, has only experienced slight shocks, while countries not very remote have been overwhelmed by disaster. For example, in the series of earthquakes taking in the years from 1750 to 1755, England had a scarcely noticeable shake. In the same series of disturbances Adrianople, Cairo, Kaschan, Lisbon, Malaga and other cities were overwhelmed, 40,000 persons perishing at Cairo, 40,000 at Kaschan and 50,000 at Lisbon.

But even these were not the most destructive earthquakes. In 1693 Catania, in Sicily, with its 18,000 people, was literally swallowed up, not a trace of city or people remaining. At the same time fifty-three other cities and 300 villages of Sicily were destroyed, and with them over 100,000 people perished. In

1703 in an earthquake at Jeddo, Japan, 200,000 people perished; in 1731 over 100,000 people were swallowed up at Pekin, China; in 1797 over 40,000 people in South America were buried in a single second.

Although of the 225 earthquakes which have occurred in the British Islands only two or three have resulted in injury to property or loss of life, panics in regard to earthquakes have been as common in England as in Central America, where shakings up are of common occurrence. The story is told that when in April, 1750, a lunatic predicted an earthquake for the 8th, thousands of people of London, spent the night of the 7th in carriages and tents in Hyde Park.

In the earthquake of April 22d the shock was felt most in the towns lying near the east coast in a line extending from London to the northeast through Chelmsford, Colchester and Ipswich to Yarmouth, being most severe at Colchester and Ipswich.—*Chicago Inter Ocean.*

MATURITY AND LONGEVITY AS AFFECTED BY CLIMATE.

W. PERKINS.

Pope long since affirmed that

"The greatest study of mankind is man."

In accordance with this is the study of nature. Her analogies and harmonies are interesting, wonderful and charming. In no region of our vast country, as for the last three months it has seemed to me, can the wealth of these analogies and harmonies be found in greater profusion than in the "Floral State," where I now write. Coming from the colder northern clime down the great Mississippi in February, spending a fortnight in the Crescent City, as her splendid parades closed I passed on a long railroad run east to Jacksonville, the lovely gateway of Florida. Here as the first days of spring opened, all the charms of the ninety days of spring as found further north, seemed to meet in rapturous harmony. A northerner without his almanac, could scarcely tell whether he had tranced into an April, May or June day. VanWinkle-like it seemed to me as if I had slumbered in my two or three days and night's passage, through fifty, into a new season and a new world. It may be seriously questioned whether a finer or more congenial climate can be found in our world than in central and eastern Florida. Surrounded as is the peninsula by the Gulf upon one side and the Atlantic upon the other, washed by the pellucid streams and gentle rivers, of which the broad St. John is chief, the climate is tempered into its mild and lovely nature the year round.

As warmth and moisture are essential to growth, vegetables here start more promptly and mature more rapidly than further north. Seeds swell ready to sprout, in a warm moist atmosphere, occasionally in a fog, before going into the ground. The dews are heavy, at times dripping from the eaves of houses, and the occasional fogs dense, though clearing away as the sun rises an hour above

the horizon. As vegetation may partially wilt under the noonday rays, it revives and grows from early evenings till late mornings in the gentle breezes and these refreshing dews. Hence there is no hazard in planting, nor any need of "Job's patience" in waiting for the harvest. Not only may the husbandman reap that he sows, but almost as he sows. Mr. Varmadoe came near Thomasville, Ga., thirteen years ago, reduced to poverty by the war, stuck a dozen switches cut from a Leconte pear tree in the ground; they grew and have made him and three sons independent—spreading to hundreds of other families in like manner. Peaches, plums and all kinds of fruit, save such as the orange, will bear in one and two years from their seed. The fruit is often seen bending to the earth the little twigs trying to bear it.

From the unprecedented cold throughout our land, the spring even here was two weeks late. Neverthless, ripe strawberries were in the Jacksonville market the last week of February, and are abundant, as I write, the last day of May, and will be gathered from the same vines on until the last days of June. Mulberry trees growing in our yard have been yielding fruit for two weeks, and are yet having a succession of young berries which will continue to ripen for at least five or six weeks longer. So of the dewberry, the blackberry and, in a word, all the berries and fruits maturing in this climate. Though no one specimen may resist decay longer than elsewhere, yet the entire crop lasts much longer. Indeed, while the general law, that quick life and early maturity indicate early death, in this climate races considered all together seem to form exceptions. The luxury of vegetables fresh from gardens and fruits from groves and orchards may be enjoyed nearly the year round.

Besides, we find an early fruitage anolagous to the early rapid growth. In a garden near by there are a half-dozen little peach twigs two years from their seeds, each bearing fruit, ripening and which will be ready for the table in a fortnight. In another garden near by is an orange growing on a bud inserted into its stock last October, and as far as can now be seen will, by supporting its weight upon the tender twig, mature for use in due time. These are but fair specimens of the prolific nature of the vegetable kingdom in this climate.

The same law as to early maturity and productiveness is found in the animal kingdom. The infinite variety of species common to north and south, small and great, start, grow and mature earlier, in the south, while a few peculiar to the latter clime follow the same fast law. With the same analogy as to size, starting earlier and growing faster, so do animals and vegetable grow larger. The huge trees in the southern and warmer climates are known to all, the larger men and women are observed by many. In Kentucky and Tennessee they are taller than in Maine, New Hampshire and Massachusetts, while in Alabama, Georgia and Florida the average weight of one kind is above that found in the New England States. That, as we have said, youths in the far South mature earlier, there can be no question. Puberty, in Florida and the West Indies, precedes by two or three years man and womanhood as reached in Maine and Nova Scotia.

That longevity is the more common in the South may be questioned. According to the general law it would seem to be less common. Yet reasoning more closely from cause to effect, the result may seem different. A vigorous internal and external cause of life, may, and probably does cause tenacity of life. Friendly environments, other influences being equal, would evidently prolong it. Sudden changes of weather tax the system with drafts upon its vitality. When the change is severely cold the draft is so much the heavier. This often occurs in the northern States, seldom if ever in the southern. Near one-half the territory of Florida is never visited with frost or ice. Even where regions are found north, liable to few changes, the weather is regularly and severely cold from November to March, constantly calling on the vitality of the system to defend it against the disagreeable chill. This tends to shorten the sufferer's days, and is of course unfriendly to longevity. If analogy may be argued from the vegetable kingdom the same result will be reached. Trees are found larger and older in mild climates. The sizes attained in South America, California, and similar climates are marvelous. Soil and climate being favorable to their growth, and meeting with little or no impediment from winters, they grow faster and longer. Indeed it is yet unknown how long and how large may be their growth. The same may be said of some tropical animals. To mention none but the elephant, is to indicate the tendency of a mild, salubrious clime to prolong animal life. Of this huge beast the same may be said as of the huge trees: the age to which the tribe may attain is unknown. The limit of its life yet remains to be discovered. Then if life is desirable and death to be dreaded, other things being equal, the South is the better place to live. But, of course, all other things are not equal. Almost in all respects diversity between the two sections—the North and the South—obtains. Each has its pleasant and unpleasant, its happy and unhappy, peculiarities. The wiser course is to compare and strike a fair balance. This too is to be done in accordance with a knowledge of the constitutions, ages and circumstances of the parties. For weak lungs the mild and the dry air of the South is favorable. As a test of desiccation in certain localities, the long pendant tree-moss is reliable. Its nutriment in part is from a humid atmosphere. In high, dry regions it is seldom if ever seen. Hence its absence is a favorable indication for the abode of consumptives, as has been proven by experiments. The congenialities and harmonies of nature invite our consideration and enjoyment. Collide with nature and the just penalty of pain ensues; harmonize with nature and the just reward of pleasure is realized. Taking large and liberal views of life—patiently studying out the connections between causes and effects, we may attain to the chief end of life and even purity and felicity.

JACKSONVILLE, FLORIDA.

RT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

e usual summary by decades is given below.

ATURE OF THE AIR.	May 20th to 30th.	June 1st to 10th.	June 10th to 20th.	Mean.
D MAX. AVERAGES.				
. . . .	57.°	59.°	65.°	. .
. . . .	79.°	90.°	90.°	. .
nd Max	68.°	74.°	78.°	. .
. . . .	22.°	31.°	25.°	. .
LY OBSERVATIONS.				
. . . .	56.6	63.8	70.8	63.7
. . . .	71.7	75.7	86.2	77.9
. . . .	60.4	64.0	71.3	65.2
. . . .	62.3	67.8	76.1	68.9
E HUMIDITY.				
. . . .	.907	.879	.859	.88
. . . .	.706	.741	.607	.69
. . . .	.848	.878	.871	.87
. . . .	.799	.833	.779	.81
E AS OBSERVED.				
. . . .	28.947	28.925	29.015	28.962
. . . .	28.931	28.928	29.093	28.984
. . . .	28.957	28.850	29.011	28.962
. . . .	28.945	28.901	29.040	28.969
ER HOUR OF WIND.				
. . . .	. .	. .	. .	. .
. . . .	. .	. .	. .	. .
. . . .	. .	. .	. .	. .
miles	3680	2122	1902	7704
O BY TENTHS.				
. . . .	5.0	6.9	4.4	5.4
. . . .	6.9	6 2	4.6	5.9
. . . .	4.6	3.8	5.6	4.6
. . . .	0.44	2.06	0.83	3.33

e first twenty days of June have been moist and warm, but not hot. The ade of May brought but little rain. There have been eight thunder storms tation in the period of this report, but no wind of great violence. As this season southerly winds have prevailed. At the date closing this re- une 20th, corn is making very rapid growth and recovering from the re- effects of cool weather and late planting. The northeastern part of the more backward in its corn crop than other parts, but wet weather has neral throughout the Kansas.

ASTRONOMY.

HABITABILITY OF OTHER WORLDS.

PROF. ALEXANDER WINCHELL, LL.D.

The habitability of other worlds is a question on which a vast amount of speculation has been expended. It has been the general belief that many other worlds are inhabited. Dr. Lardner argued the habitability of the Moon and all the planets. Dr. Brewster held similar views. Some have even maintained that the physical condition of the body of the Sun may be such as to produce a state of habitability. Sir William Herschel is said to have conjectured that the solar spots are the highest points—some 600 miles high—of a cool and habitable globe.

On the contrary, the habitability of other worlds has been denied on the theological grounds. It was formerly a common theological belief that the biblical teaching is incompatible with the doctrine of other worlds of beings. Dr. Whewell disputed the plurality of worlds by appeal to scientific evidence.

The question of the habitability of other worlds has generally been discussed from the assumption that all other corporeal beings must be clothed in flesh and bones similar to those of terrestrial animals, and must be adapted to a similar physical environment. But it is manifest, on a moment's consideration, that corporeality may exist under very divergent conditions. It is not at all improbable that substances of a refractory nature might be so mixed with other substances, known or unknown to us, as to be capable of enduring vastly greater vicissitudes of heat and cold than is possible with terrestrial organisms. The tissues of terrestrial animals are simply suited to terrestrial conditions. Yet even here we find different types and species of animals adapted to the trials of extremely dissimilar situations.

Nor is it to be supposed that the plans of structure of animals on other habitable planets bear necessarily any analogy to organic plans on the earth. That an animal should be a quadruped or a biped is something not depending on the necessities of organization, or instinct, or intelligence. That an animal should possess just five senses is not a necessity of percipient existence. There may be animals on the earth which neither smell nor taste. There may be beings on other worlds, and even on this, who possess more numerous senses than we. The possibility of this is apparent when we consider the high probability that other properties and other modes of existence lie among the resources of the cosmos, and even of terrestrial matter.

There are animals which subsist where rational men would perish—in the soil, in the river and the sea. No reason can be assigned why aquatic respiration should be confined to brute animals. On a planet without land, like Uranus,

high intelligence might be enframed in a gill-bearing embodiment; and resources and stimuli for intellectual activity might be discovered in the bottom of the ocean, or in the infinitesimal world which fills a slimy pool, or "swarms upon the thickly peopled air." Nor is incorporated rational existence conditioned on warm blood, nor on any temperature which does not change the forms of matter of which the organism may be composed. There may be intelligences corporealized after some concept not involving the processes of ingestion, assimilation and reproduction. Such bodies would not require daily food and warmth. They might be lost in the abysses of the ocean, or laid up on a stormy cliff through the tempests of an arctic winter, or plunged in a volcano for a hundred years, and yet retain consciousness and thought. It is conceivable. Why might not psychic natures be enshrined in indestructible flint and platinum? These substances are no further from the nature of intelligence than carbon, hydrogen, oxygen and lime. But, not to carry the thought to such an extreme, might not high intelligence be embodied in frames as indifferent to external conditions as the sage of the western plains or the lichens of Labrador—the rotifers which remain dried for years or the bacteria which pass living through boiling water. Again, there is no reason why a given amount of light should accompany intelligent organization. Many animals, not among the least intelligent, find the night their appropriate period of activity. Some exist and thrive in rayless caverns and ocean depths. On a planet dimly lighted, like Neptune, men might be organized with pupils as large as silver dollars, or even as large as dinner plates. Vision might be as distinct on Neptune as on the earth. As to warmth, a blanket of vapors may keep it in and accumulate it to the requisite extent. And in that distant time when the Sun shall become planetary, large-orbed men may move about in starlight over a surface sufficiently warmed by internal heat, and forms of vegetation may flourish and supply food for man and beast without the stimulus of solar radiations. These suggestions are made simply to remind the reader how little can be argued respecting the necessary conditions of intelligent, organized existence, from the standard of corporeal existence found upon the earth. Intelligence is, from its nature, as universal and as uniform as the laws of the universe. Bodies are merely the local fitting of intelligence to particular modifications of universal matter and force.

But let us consider how far other worlds are suited for habitations for beings akin to ourselves. This is a question for scientific consideration. The answer to the question, when asked with reference to each of our planets, is to be sought in what has been already said concerning the physical conditions of the planets. Mercury is not habitable for beings like ourselves. Proximity to the Sun results in a destructive degree of heat, if it does not actually prevent all water from finding a resting-place on the planet's surface. The Sun's apparent diameter from Mercury is more than two and a half times as great as from the earth.

In reference to Venus, and possibly also Mercury, we must bear in mind that the relations of heat and water are such that water might exist as a dense and permanent envelope of clouds. This seems the more probable, even for

Mercury, in view of Professor Langley's determination of the astonishing rate of radiation in a thin atmosphere. At the upper limit of an atmosphere sufficiently dense to support aqueous vapor, it seems not irrational to assume that escape of heat would be rapid enough to condense water even in the fierce solar heat experienced at Mercury's distance from the Sun. So far as the existence of a stratum of clouds is possible, this would, of course, serve as a screen for the surface of the planet, so that comparatively little of the Sun's direct radiation would interfere with habitability. In this view there seems no great improbability that both these planets are inhabited by intelligences organized somewhat like ourselves. The amount of water belonging to these planets being in less proportion than on the earth, the processes of evaporation and precipitation must keep it in active circulation. No very considerable bodies of water can be supposed to exist, and a large proportion of the entire surface must be accessible to occupation and cultivation. The final absorption of the water will, therefore, occur at a relatively early epoch, when, of course, habitability must end.

Thus, the first thought of these sister worlds suggests that they may be the homes of beings kindred to ourselves. Then the knowledge of the intensity of the solar radiations on their surfaces seems to preclude the belief in their habitability. But finally, a discovery of natural means for the alleviation of excessive heat leaves us with the conviction that after all we may have neighbors on the contiguous planetary territory. As to their organization, while it is profoundly true that under circumstances extremely diverse from those under which we live, extremely diverse organizations must be conceived both possible and probable; yet where the divergence is no greater than on the interior planets, all the fundamental functions and processes may be conceived analogous to our own. There is so widespread uniformity in the nature and action of physical forces that we may suspect the same in regard to organic structures and activities. As organization in its forms and functions is conditioned by the properties of matter and the laws of energy, and these conditions are widely pervasive throughout our system, we have good ground for believing that plans of organization and modes of activity are fundamentally analogous under all planetary conditions not more diverse than we conceive those of the earth and the interior planets to be. In fact, there exist contrasts of condition upon the earth nearly as wide as the contrasts between the earth and Venus. In all these contrasted situations nature employs the same fundamental plans of organization and functioning.

On the whole, as intelligence must be revealed in the cosmic organization of Mercury and Venus, there are presumably intelligent beings in correlation with the intelligible world; and as the conditions of corporeality are so far analogous to those on the earth, we may reasonably conceive organic intelligences on these planets who have power of locomotion by muscles and bones; who eat and respire; who suffer and enjoy; who cognize light and heat and sound; who observe and reflect, imagine and aspire; and, while ignorant, probably, of many or most of our arts, have invented many others of which we never dreamed, and achieve accomplishments which would be miracles to us.

The Moon, in the absence of air and water, must be without inhabitants akin to ourselves. Though the Moon has passed through the successive phases of a cooling globe, I cannot think the violence which must have reigned on its surface before synchronistic times would have permitted the existence of an organic being. Nor, since the synchronistic period began, have the conditions, as far as we can judge, been endurable. The fortnightly alternations of extreme heat and extreme cold must prove fatal to all organic life with which we are acquainted. It is pleasant to think of kindred beings on a neighboring world, though we might not by any possibility open intercourse with them. It is pleasant even to believe that the Moon may have been inhabited in a former planetary period. It creates a sense of relation to distant parts of the universe to believe that other beings may even have lived there and passed away. To know that the lunar surface is a wild scene of desolation, and to know that only the unconscious forces of inorganic nature have ever interrupted the oppressive silence of the planetary solitude, seems to sunder a bond of sympathy with the universe, and isolate mankind on an island rock where no message can ever arrive. But it is better to know the truth than to indulge in fancy. The Moon is probably no more uninhabitable in the present period than it has been during its entire history.[1]

Mars, according to the scientific indications, presents conditions more nearly approximating the demands of habitibility than any other planet besides the earth. It seems almost certain, however, that the meridian of its habitable phase is passed. The Sun's apparent diameter from Mars is two-thirds his size seen from the earth, and his light and heat are only three-eighths as much as the earth receives. As the intensity of gravity on the surface of Mars is only three-eighths the intensity of gravity on the earth, many diverse conditions would be introduced. A man of ordinary agility would be able to leap over a wall twelve feet high. If on the earth a strong man is able to support 26 pounds in his palm at arm's length, and his arm is equivalent to four pounds in his palm, he might be forty-two-feet high before the weight of his arm would become too great for him to extend it; but on the planet Mars, such a man might be 109 feet in height.[2]

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1 In my brochure, entitled *Geology of the Stars*, speaking of the comparatively rapid succession of lunar periods, I said: "The zoic age of the Moon was reached while yet our world remained, perhaps, in a glowing condition. Its human period was passing while the Eozoön was solitary occupant of our primeval ocean." Mr. Fisk in his *Cosmic Philosophy* (i, 400, note), has cited this as "an example of the too hasty kind of inference which is often drawn in discussing the question of life upon other planets." Mr. Fisk misapprehends, for it is not stated that human beings ever lived, or could have lived, upon the Moon. The allusion is simply to that stage of lunar evolution which corresponded to the human stage in terrestrial evolution.

2 If $w =$ the total weight a strong man's arm can support, including weight of arm and load, and $p =$ weight of arm, and $n =$ number of times greater, in any dimension, the arm is which could bear no load, then $n = \frac{w}{p}$ (Young's *Mechanics*, Williams' ed., p. 113), and if $g' =$ gravity on any planet compared with gravity on the earth, then, on that planet $n = \frac{w}{p g'}$.

Now, if we assume that a man can raise 26 pounds at arm's length, and that his arm is equal to 4 pounds in his palm, then $n = 7.5$; and if a strong man's height is 68 inches, the height of a man on the earth who could barely extend his arm—since his height is proportional to his

Again, considering that the Martial atmosphere is likely to be .105 that of the earth, and is spread over .2828 the same amount of surface its density on the surface of the planet is only .1379 that of the earth's surface atmosphere, giving a pressure on the mercurial barometer of about 4.14 inches. The height of the Martial atmosphere reduced to uniform surface density would be 2.694 times that of the earth's atmosphere, or about 13.56 miles. The surface density of the Martial atmosphere is only such as would be attained on the earth at the height of 10.2 miles.[3] This implies a universal state of atmospheric tenuity on the surface of Mars which has not been found compatible with any terrestrial life. The simple difference in mass creates conditions which would render the surface of Mars completely untenable by any human being; and this consideration, it might have been stated, applies as well to Mercury and the Moon. But this is no proof that organic beings suited to such atmospheric pressure do not exist. Animals are dredged from oceanic depths where the pressure as much exceeds the sea level pressure as the atmospheric density of Mars falls below the terrestrial standard. Animals are adapted as they are because the conditions are as they are; and we may feel assured that if the conditions were different, organic adaptations would be different correspondingly. The conceivable range of adaptations is limited only by the physical properties of inorganic matter.

On the planet Jupiter, the mass so much exceeds that of the earth that all the relative conditions are reversed. I have shown that atmospheric density is nearly six and a half times as great as on the earth. Hence respiration would only need to be six and a half times less active. On the contrary, the force required to sustain the body against gravity would be more than two and a half times as great, and all weights would be two and a half times as difficult to move. This increased weight of the body and limbs would render comparatively less efficient similar muscular efforts, while the gravitational resistances to be overcome would be greater. A man sixteen and a quarter feet high would be barely able to extend his arm at a right angle with his body. If ever the planet Jupiter attains a habitable condition its organic beings will be limited in some such manner as these numerical results imply.

The apparent diameter of the Sun from Jupiter is only .2392 or $\frac{1}{4.2}$ the same from the earth; and the Sun's radiant energies in the forms of light, heat, actinism and attraction, are only $\frac{1}{27}$ of the same at the earth. Were the Sun's heat

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arm's length—would be 68 inches × 7.5 = 42.5 feet; and the height of such a man on Mars would be $\frac{42.5}{.391} = 108.95$ feet.

3 If h = the height at which the density of the earth's atmosphere is $\frac{1}{n}$ that at sea level, then, since the density diminishes in a geometrical ratio as the height increases in an arithmetical ratio, the height $2h$ will give a density of $\frac{1}{n^2}$; the height $3h$ will give a density if $\frac{1}{n^3}$, and generally the height $x\,h$ will give a density of $\frac{1}{n^x}$. But $\frac{1}{n^x} = .1379$, whence, of $n = 2$ and $h = 2{,}705$ miles, $x = 3.77$ and $x\,h = 3.77 \times 2.705 = 10.2$ miles.

reduced on the earth to $\frac{1}{27}$ its present amount, it is manifest that all organic life must perish. If ever, therefore, the inherent temperature of Jupiter subsides so far as to bring his surface condition to that of the earth, no Jovian climate will be such as animal organization can endure. As his actual surface temperature, however, will always be compounded of the effects of solar radiation and of conduction from within, there will be an epoch when his actual mean surface temperature will be the same as the earth's actual mean surface temperature. The vicissitudes of the seasons will be $\frac{1}{27}$ as great as on the earth—regardless of the effect of less obliquity of the axis—and the diurnal and nocturnal fluctuations of temperature will be only $\frac{1}{27}$ as great. Owing to a denser atmosphere, the fluctuations will be even less than this. The higher inherent temperature of the soil will result in so much radiation from the planet that on a planet with so large a supply of water, and in an atmosphere so dense as Jupiter's the Sun's deficient heat may be largely compensated by suppressed radiation from the planet. The situation will be that of a mild and dimly lighted "stove" in horticultural operations, highly suitable for the growth of mushrooms. It will be perpetual evening. It can not be doubted that corporeal intelligences might be coördinated to such a physical condition. For the present, however, we have not the slightest grounds for imagining the existence of organic populations upon the surface of Jupiter, unless they depart in some very extreme way from the terrestrial standard.

As to the planets remoter from the Sun, I have offered reasons for considering them advanced to a state of total refrigeration. They cannot therefore, be conceived as habitable. There was a time, however, in the history of each, when its stage of cooling produced a surface temperature suited for organic life. At that stage, the relations of organic beings on their surfaces were similar to those which may be anticipated for Jupiter, with all the greater divergences from the terrestrial condition which depend on distance from the Sun carried to successively greater extremes and successively larger proportions of water and gaseous substances. On Neptune the apparent diameter of the Sun is but $\frac{1}{30}$ the Sun's apparent diameter to us, and his heat and light are reduced to $\frac{1}{900}$ the heat and light received by the earth. This light would, nevertheless, be equal to about sixty-nine of our Moons. The excess of water however, on all the distant planets, in accordance with views heretofore presented, would probably render them, in all stages of existence, totally uninhabitable for beings like ourselves. But it is always to be remembered that other beings suited to the actual exigences of the environment, may have occupied the situation.

The earth, then, so far as we can reason, is in the middle of the habitable zone of the solar system, if our own natures are assumed as the criterion of habitability. On either side, the rigor of the physical conditions seems to proclaim our system a voiceless and lifeless desert. Even our near neighbor, the Moon, lies on the borders of this desert. Within the vast limits of the solar system there is but one happy niche where corporeal organization according to our standard can enter into material relations with the physical environment. The conclusion

is undoubtedly disappointing. But the impression is further deepened by the reflection that on our own congenial planet life is hemmed in between the terrestrial surface and the upper limit of a film of atmosphere not thicker than the mean depth of the film of ocean which enwraps the solid globe. The entire human family swarms within a sheet of atmosphere not over three miles thick. Above, are the rigors of unendurable cold and the horrors of unsupported respiration. Below, are the impenetrable rocks or the submerging waves or the internal fires. Even the space about us and nearest to us is, for the greater part, inaccessible to man, and unvisited by any organic being. We need not wonder that corporeal existence is a rarity through all the realm of our system.

But there are other suns and other planetary systems, and other worlds which possess the conditions of habitability. When we look on the hosts of stars, and consider that if only one habitable planet wanders about each sun, we understand that the number of habitable worlds is countless. In this view, space seems to be densely populated. We have neighbors; they live beyond impassable barriers, but they gaze on the same galaxy, and we know they are endowed with certain faculties which establish a community between them and us. However conformed bodily, whatever their modes and means of organic activity, we know that they reason as we reason, and interpret the universe on the same principles of logic and mathematics as ourselves. The orbits which their planetary homes describe are ellipses; they have studied the same celestial geometry as ourselves; they have written their treatises on celestial mechanics; they have felt the impact of the luminous wave of ether; they have speculated on the nature of matter and energy; they have interpreted the order of the cosmical mechanism as the expression of thought and purpose; they have placed themselves in communion with the Supreme Thinker, who is so near to all of us that his voice is audible alike to the ear of reason in all the worlds.—*World Life.*

ARCHÆOLOGY.

NATURAL AND ARTIFICIAL CURIOSITIES OF THE GILA COUNTRY, NEW MEXICO.

Mr. G. M. Shaw, of this city, has just returned from a month's trip to the Gila River country in the southwestern portion of Socorro County, where he went with Messrs. Brown and Bergen to survey and report on the recent alum discoveries there, which have been located by a company of Socorro citizens.

Mr. Shaw reports almost a solid mountain of alum over a mile square, some of the cliffs of which rise to an elevation of 700 feet above the river bed. Most of the alum is in an impure state and tasting very strongly of sulphuric acid, but of which there seems to be an inexhaustible quantity. Some of the cliffs, how-

ever, show immense quantities of almost pure marketable alum. This alum find Mr. Shaw tells us, is on the Gila River about two miles below the fork of the Little Gila and four miles below the Gila hot springs.

Mr. Shaw reports numerous hot springs in that section, most of them gushing out of the rocks that form the river banks, some of them hot enough to cook in, and most of them too hot to hold the hand in. The main hot springs referred to above are reported to have effected wonderful rheumatic and other cures. The country is abundantly watered and wooded and is covered with the finest of grass. The Gila is full of trout and other fish. Game, while still moderately plentiful, has been mostly scared away from the region of the hot springs by professional and other hunters, as well as ranchmen, who are beginning to locate in this difficult-to-get-at section of the Gila. At present the only way to get into this section is with pack animals over a precipitous trail of several miles, wagons having to be abandoned in the gorge of the Litttle Gila on the North Star road, about two miles from the hot springs and about seven miles from the alum find, going from Socorro or from the Black Range. By the way of Silver City and Georgetown wagons are abandoned on "Sapio" creek with about eighteen miles northward of pack-animal trail to the hot springs.

Mr. Shaw being an amateur photographer, also, invariably carries his "outfit" along on his surveying trips, combining pleasure with business, and bringing back with him photographs of all objects and scenes of interest that he meets with on the way. He brings back from this trip over sixty photographs of the Gila country, among which are a number of exterior and interior photographs of some interesting cliff-dwellers' ruins he encountered in a cave about four miles west from the hot springs.

The cave, he says, is in a cliff which forms one side of a deep narrow gorge or cañon; it has but one entrance, which was strongly fortified; but above and beyond the entrance the cave has two porch-like openings into the face of the cliff, under and through which can be seen, from the opposite side of the cañon, the buildings extending back into the cave. Mr. Shaw says: "After a somewhat difficult climb of about 100 feet from the bottom of the gorge I reached the entrance, which is around a corner or angle of the cliff, and passing through an opening in the fortification wall and through several rooms behind it, after ascending a little slope, I found myself on the floor of the cave, which was on a level with the top of the entrance. The floor is covered with a fine, impalpable dust to a considerable depth. This cavern was of circular form, about fifty feet across and, perhaps, fifteen or twenty feet high. Looking northeast and parallel to the face of the cliff one sees the whole length of the cave, which by reason of its other front openings gives it the appearance of a porch-like gallery.

The cavern above the entrance is quite dark and seems to have been used for corral purposes, as it has no building except at the entrance. Going toward the first porch the cavern narrows down to a small passage, where the buildings begin and are continuous from here through a similar passage into the second porch. There are about twenty-five houses or rooms in the cave, varying in size

from five feet square and high to ten by twelve feet square and nine feet high. The passage is mostly from one room to another. The doorways, however, are only about eighteen to twenty-four inches high and twelve to eighteen inches wide, placed on or near the floor and form the only openings into rooms that do not need another for passage-way. The walls are made of shale stone, one and one-half to two inches thick, laid in mortar, which is almost as hard as the stone itself. The walls are about nine inches thick and as straight and plumb as any modern brick wall.

Some of the houses are two stories high. The roofs have all been burned down, the only woodwork escaping being here and there the projecting end of a rafter from the wall and the cross pieces over some doorway. Such projecting rafters are pine, with the bark taken off and about four or five inches thick, the cut end showing stone ax chopping. Some of the interiors are nicely plastered with mortar and decorated with colors and designs, seen on Indian pottery, but I am sorry to say that vandal hands have almost obliterated these decorations by scratching their names over them, perhaps in hope that their names may be perpetuated in photographs that might be attempted of these decorations. As these decorations are so obliterated by vandal inscriptions, and a photograph of them would have simply been a photograph of the vandal names, I did not waste a plate on them but left them to be execrated where they are whenever seen. Buried in the debris may be seen broken pottery, pieces of old rotten arrows, wicker work, remnants and pieces of a coarse cloth made from soap weed fibre, corn cobs the size of pop corn cobs, and innummerable other articles of household refuse. In bones I found but a single human molar tooth, with the enamel dropping off. Opposite the entrance to the main cave, in the return angle of the cliff, is another smaller cave, also with building (about half a dozen rooms), which probably was a guard cave, commanding and defending the entrance to the main cave. At the other end and a little beyond the main cave, is another large cave with a steep and sloping floor, the debris down which, with the superincumbent huge boulders, plainly show that the buildings in this cave were ground to atoms and carried down the slope with probably everything and everybody in them, by the falling of an immense layer from the ceiling of the cave. An excavation here might a tale unfold. Hanging rocks in the cave still look threatening. Whether this catastrophe caused the abandonment of the adjoining caves and the burning of their remaining homes as propitiatory offerings by their horrified and terrified dwellers is part of the mystery that now alone haunts the caves that were once the home of the cliff dwellers.—*S corro Bullion.*

ANCIENT RELICS IN ILLINOIS.

On last Friday, May 2d, Prof. R. L. Witherell, of Davenport, and C. A. Dodge, of Albany, assisted by some other of our citizens, dug a hole about eight by ten feet, and about six feet deep, into one of the Albany mounds. As a result

of their labor they found two skeletons, one of a male and the other of a female of the human family. Neither was in a good state of preservation, but the skulls, thigh bones, and larger bones of the legs were secured. A large number of shell beads were picked up near the neck of the male skeleton, and a corrugated piece of copper, about as large as a man's hand, plated with silver, was also found lying close to the beads.

Mr. Dodge thinks that the copper plate was strung to the beads, and was, no doubt a rare ornament when manufactured. He thinks, from what he has read in science, that the Albany mounds and their contents are over two thousand years old. The copper plate he regards as a rare relic, and thinks that its duplicate has never before been found. At least there is no record of it. About the ankles of the male skeleton similar beads were also found. Mr. Dodge thinks the skeleton to have been undoubtedly that of a chieftain and the female skeleton that of his wife.

The Albany mounds, he says, are the finest on the Mississippi river. He never yet opened a mound without being more than repaid for his labor by finding many curious ancient relics of the strange people known to history as the mound builders. A great many skeletons are often found in one mound, and sometimes the largest mounds contain but one or two skeletons. He thinks that the mound builders buried their leaders and chieftains apart from other people, who were buried less pompously, by many of them being buried in one grave or mound. At no distant day he thinks that another mound may be opened.

The contents of the Albany mounds have proven of much value to scientists already, and our little city may expect at any time a visit from distinguished men of science and study, who think it well worth their time to investigate these wonderful sepulchers, and especially when they have proven so productive of wonderful and curious relics as have the Albany mounds.—*Albany* (*Ill.*) *Times.*

OLD EGYPT.

Statements in regard to the scope and purpose of the coming European conference upon Egyptian affairs are so various and contradictory that it is impossible, at this date, to even guess intelligently about the final result, so far at least as details are concerned. But it is reasonably certain that some definite decision will be reached by the conferring parties, so that when their deliberations are concluded and the arrangement agreed upon duly confirmed, a new chapter will open in the eventful history of a nation whose most vigorous and glorious life ended before history began. For the first time since Egypt ceased to be a province of the Roman Empire, she will be brought under the controlling and direct influence of European civilization; for Turkey, though in Europe, is not of it and Egypt has lost rather than gained by her connection with a power essentially Oriental in principles and practices, and therefore essentially unprogressive. Without speculating upon the future now dawning, it may be interesting to glance

briefly at a past altogether unique in the annals of the world; a past so remote that when Cæsar and his Commentaries were baptized in the harbor of Alexandria, and Marc Antony lay dreaming in the arms of Cleopatra, it was even then shrouded in the mists of immemorial antquity.

It is a curious and instructive illustration of the vicissitudes of human affairs that the destinies of Egypt should now be in the hands of nations which were unborn when she had practically passed from the stage of active life; her work completed, her mission finished. Before a single stone was laid where now stand London, Paris, Berlin, Vienna, splendid cities covered Egyptian soil. When the waters of the Thames and the Seine were vexed only by the rafts or canoes of wandering barbarians, the waters of the Nile floated the barges of Egyptian kings and washed the walls of palaces and temples larger and grander than Windsor and Westminster, the Louvre and Notre Dame. When the ancestors of the English, French, Germans and Austrians of to-day were the rudest savages, struggling for precarious existence with beasts scarcely more wild and savage than themselves, the inhabitants of Egypt were a highly organized society, with all the departments of the social system in full operation, with an elaborate government, an extensive literature, and a religion from which later religions have drawn some of their noblest ideas. When the roving prehistoric people of Europe were cave-dwellers, because they knew nothing of huts, much less of houses, the prehistoric people of Egypt built the pyramids, reared the shrines and colonnades of Luxor, excavated and frescoed the rock tombs of Thebes, carved the mysterious Sphinx and the colossal statues of Rameses. When in all Europe there was not a line of written language, Egyptian monuments bore volumes of those strange hieroglyphics which are now the admiration and the study of European scholars. When throughout Europe men and women bowed down to sticks and stones, in a fetich worship as gross and degrading as that of the negroes of Central Africa, an Egyptian priest—on a papyrus supposed to date 3,000 years before the Christian era—expressed a popular belief in one God, supreme and indivisible, in the immortality of the soul, and in rewards and punishments beyond the grave. The original of that ark of the covenant which Moses constructed, and which found final lodgment in the Holy of Holies at Jerusalem, is still to be seen in an Egyptian painting done before the great Hebrew leader and law-giver was rescued from the cradle of bullrushes; and the brazen serpent he raised for the salvation of his followers in the wilderness has its counterpart among Egyptian figures designed and executed before Abraham pitched his tent in the land of Canaan. Modern civilization and culture make sufficiently generous acknowledgment of the vast debt they owe to Greece and Rome; but how seldom is it even hinted that our civilization and culture owe anything of consequence to Egypt. Yet centuries before Romulus raised his wall on the Palatine Hill, or the beginnings of Athens clustered around the Acropolis, Egypt was the world's school and library. Art and science flourished there when no sign of either was visible elsewhere. Solon went there to learn legislation, Herodotus to learn history, Plato to learn philosophy; and no great teacher in any important branch of knowledge considered him-

self competent to teach until he had sat at the feet of Egyptian masters and drunk deeply at the fountain of Egytian learning. There is some unconscious acknowledgment of our indebtedness to the men who lived and thought and toiled and died on the banks of the Nile thousands of years ago. Egyptian ideas are reproduced in our architecture and ornamentation, metaphysics and theology; Renouf, Eber, and many other brilliant intellects are devoting their lives to the manuscripts and inscriptions in which the Egyptian mind reveals itself; and more brain and pen labor has been given to the mechanism and meaning of the Pyramids than to the grace and beauty of Parthenon and Pantheon. But a broad margin of justice still remains unfilled; and whenever—if ever—full justice is done to the achievements of a vanished race, Greece and Rome will look small to an intelligent and impartial eye as compared with Egypt. The ancient kingdom of the Pharaohs occupies but an insignificant part of the earth's surface; only a narrow strip of ground on either side of the river whose annual overflow redeemed it from the desert—so narrow that at the widest place a man on horseback can cross it in less than a day, and in the upper portion in a few hours. Yet from this little spot, almost lost upon the map, influences have radiated to the farthest limits of Christendom and heathendom. It has been among the most potent factors of the world's education, and its power, though perhaps unrecognized by the majority, will be felt while the world endures. The Egypt of to-day is a mere geographical point, a bit of territory for European Governments to wrangle over, European soldiers to take and hold, European statesmen to rule well or ill as they see fit. The people who made Egypt what she was, and what she never can be again, have disappeared forever, crushed out by the relentless heel of Persian, Roman, Arab and Turkish conquerors. Their degenerate descendants are unworthy to bear an illustrious name; the mummies in the pits are entitled to more respect than the fellaheen who dig up and sell them. Ages of grinding oppression and hopeless ignorance, in which the sword and the whip have had full swing and sway, have produced their legitimate result in a cowardly and contemptible race, utterly incapable of self-government and fit only to wear a foreign yoke. But, for the sake of Egypt's past, if for nothing else, it is to be hoped that Egypt's future will be brightened and bettered by the new regime which the conference must introduce; and that the modern Egyptians may receive whatever elevation, advancement and general prosperity their capacity permits from nations which were at the bottom of the ladder when ancient Egyptians were at the top.—*Globe-Democrat.*

BOOK NOTICES.

A GRAMMAR OF THE CAKCHIQUEL LANGUAGE OF GUATEMALA: By D. G. Brinton, Philadelphia, 1884; pp. 72, 8vo.

The Maya dialects constitute a group of Central American languages which have been investigated by the Spanish missionaries with untiring industry and corresponding success from an early epoch. Their poverty in grammatic forms renders their acquisition rather easy, although the phonetic part presents some difficulty to strangers. The Maya dialects spoken in Guatemala are divided by Dr. O. Stoll, a recent investigator among the Indians of that country, into three sections, called by him the Pokonchi, the Qu'iché and the Mame group; at an early period the Qu'iché language separated into two main dialects, the Qu'iché proper and the Cakchiquel, and subsequently the latter of these formed a sub-dialect called the Tz'utujil.

There is in the library of the American Philosophical Society, in Philadelphia, a volume containing several tracts in Cakchiquel and Spanish, one of which, composed by an anonymous author in 1692 (54 pages), embodies a grammar of it and has just been published in an English translation by Dr. Daniel G. Brinton. To increase the value of this publication, the learned editor has combined with this material all the further information which he could obtain upon this guttural tongue from two manuscript grammars in his own library: that of Benito de Villacañas, a Dominican missionary in the tribe, who died 1610, and that of another ecclesiastic, Estevan Torresano, who wrote shortly after 1753. Without altering the unscientific plan which the authors have followed in their work, Dr. Brinton has at least improved it by adding numerous critical notes to the rules and paradigms of the padres, and prefaced the whole by a useful bibliographic introduction. An autographic map of Western and Central Guatemala is a very welcome addition to the volume.

A. S. G.

THE TRUE THEORY OF THE SUN, Showing the Common Origin of the Solar Spots and Corona, and of Atmospheric Storms and Cyclones: By Thomas Bassnet. G. P. Putnam's Sons, New York, 1884. $2.00.

The salient points of the "true theory" as set forth in Mr. Bassnet's book are the following:

1. All space is flooded with an ethereal fluid possessing the common properties of matter but imponderable.

2. At the sun a vortex has been formed in this fluid which keeps up a perpetual current through the system.

3. The solar spots are due to displacement of the sun from the center of the vortex; the corona and protuberances are due to the ether or electricity escaping from the sun (electricity being treated as a gas similar to air); the same theory of vortices is made to explain the formation of cyclones and tornados in the earth's atmosphere.

Mr. Bassnett and his papers will be remembered by members of the American Association who attended the Cincinnati meeting, especially the members of section A.

This book is evidently given to the world by the author in the honest belief that it is right, and that all modern science is wrong. As the result of much labor and study it deserves to be treated with respect; as a scientific treatise it contains the most glaring errors and assumptions, all of which have from time to time been pointed out.

It is somewhat interesting to note the number of persons in the United States who feel competent to give the "only true" theory of the physical universe. As in the present instance, these theories often contradict the best known laws of mathematics and physics, and go directly against the teaching and experience of the masters in science. In America there is, perhaps, a larger class of men who feel competent to propound a theory of the universe, who are ignorant of the principles of mathematics and physics necessary for such discussions, than elsewhere. Mr. Bassnett proceeds with charming *naiveté* to construct a theory in which he controverts the most ordinary principles established by men of science, and then complains most bitterly of the blindness and stupidity of these same men of science who refuse to pay any great amount of attention to his talk.

Along with its peculiar "theories" the book contains many facts of astronomy. To the student it will be worse than useless and to the scientific man valuble only as a curiosity.

H. S. P.

THE WOMAN QUESTION IN EUROPE: Edited by Theodore Stanton, M. A. Octavo, pp. 478. G. P. Putnam's Sons, New York, London and Paris. For sale by M. H. Dickinson, $3.50.

This is a series of essays by capable writers—mostly women—of England, Germany, Holland, Austria, Norway, Sweden, Denmark, France, Italy, Spain, Portugal, Belgium, Switzerland, Russia, Poland, Bohemia, and the Orient, upon the movement in recent times for the amelioration of the condition of women in all these countries. In the arrangement of the chapters an ethnological order has been maintained, viz.: Anglo-Saxon England, the Teutonic countries, Scandinavia, the Latin nations, the Slavonic States and finally the Orient.

The work is rather a compilation of facts upon than a philosophical study of the subject, though several of the essayists have given in their papers the results of profound and critical consideration of its various branches. Thus, in the chapter upon England we find discussed first, the Woman's Suffrage Movement;

second, the Women's Educational Movement, the Women in Medicine, the Industrial Movement, and Women as Philanthropists. In that upon Germany a general review of the movement is given, as well as an account of the National Association of German Women, and in that upon Italy a general review and a history of the Educational Movement. Among the English essayists, one of the principal is Mrs. Fawcett, wife of Mr. Henry Fawcett, Postmaster-General of Great Britain, and Professor of Political Economy in Cambridge University. Mrs. Fawcett was led to study the same subject through reading to her husband, who is blind. She was one of the foremost women in England in publicly advocating and discussing the political enfranchisement of women, and is a competent authority on all similar subjects. The other English writers in the volume are Mrs. Maria G. Grey, Francis E. Hoggan, M. D., Miss Jessie Boucherett and Mrs. Henrietta O. Barnett, all able and distinguished in their several spheres. Their contributions fill nearly one-third of the work, which, in view of the marked progress made in Great Britain in the direction of the political rights of women, is entirely proper. As Miss Cobbe says in her introductory chapter, "Of all the movements, political, social and religious, of past ages, there is, I think, not one so unmistakably tidelike in its extension and the uniformity of its impulse as that which has taken place within living memory among the women of almost every race on the globe. Other agitations, reforms and resolutions have pervaded and lifted up classes, tribes, nations, churches. But this movement has stirred an entire sex, even half of the human race. * * * . But the crown and completion of the progress must be the attainment of the political franchise in every country wherein representative government prevails, and till that point be reached there can be no final satisfaction in anything that has been achieved."

For any one desiring a compendious history of the woman question in all lands, written by the most competent writers and edited by a careful and conscientious editor, this work is about all that can be asked.

SHAW'S NEW HISTORY OF ENGLISH LITERATURE: Edited by Truman J. Backus, LL.D. 12mo., pp. 480. Sheldon & Co., New York and Chicago, 1884. For sale by M. H. Dickinson, $1.25.

For a number of years past Thos. B. Shaw's "Outlines of English Literature" has been regarded by teachers as a standard work. In its revised form it presents many improvements in arrangement, unity and simplicity of style. President Backus has given a fuller discussion of the old-English and middle-English literatures; an assignment of prominent positions to the most famous writers: a free use of quotations from the works of the best English and American critics; a collection of references to the best collateral readings upon the topics considered, and the use of a few simple diagrams for the aid of students in remembering important classifications of authors. The chapters upon English literature in America are the sole work of President Backus himself, and are very complete, having been entirely re-written for this edition.

DERN FOREST ECONOMY: John Croumbie Brown, LL.D. 12mo., pp. 228. Edinburg. Oliver & Boyd.

In furtherance of an International Forestry Exhibition in Edinburg in 1884, hich a number of scientific, practical, and professional gentlemen pledged r assistance and co-operation at a meeting held in March, 1883, Dr. Brown has ared this little work. It is intended as an introduction to the study of for-, so that those who read it will be better prepared to appreciate and be ben-d by the proceedings. It embraces an account of the origin of forests and consequences of their destruction; chapters upon the ancient forests of En- and their disappearance, together with an indication of the evils that have wed their destruction, such as floods, inundations and torrents, avalanches slides and sand drifts; also upon forest conservation, sylviculture, diseases of , forest administration, etc. Dr. Brown has devoted a good share of his to this subject and may be regarded as a standard authority on all branches

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UNITED STATES ART DIRECTORY AND YEAR BOOK: Compiled by S. R. Koehler. Octavo, pp. 440, including engravings. Cassell & Co., New York, London and Paris, 1884. For sale by M. H. Dickinson, $2.00.

This work is intended as a guide to all persons interested in the progress of art patrons, students of art and its history, and travelers of an artistic turn nind, by pointing out to them the facilities existing in the United States for enjoyment, the study and the commerce of art. It contains a chronicle of its in the art-world like exhibitions, sales, museums, and private collections, stion of tariff, copyright law, etc.; also lists of national and local institutions oted to art, a directory of artists and of art teachers; to which is added a ified index of everything in the book. Nearly two hundred pages are de-d to the "Souvenirs of Exhibitions" being engraved copies of the very best paintings, water colors, drawings, etchings, etc., that have been exhibited by erican artists in this country and Europe within the past year. For the pur-s of artists themselves or patrons of art, this book—the second in the series—be found very useful. It is handsomely printed and the engravings are un-lly well done.

CENTURIES OF WORK AND WAGES: By Jones E. Thorold Rogers, M. P. Octavo, pp. 591. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson. $3.00.

The first part of this massive book is devoted to an account of early English ety up to and during the latter half of the 13th century and particularly of principal pursuit of the Englishmen of that period, agriculture; also to the ipations of the townspeople, and finally with the various classes who made up iæval society; all of which is embraced in the first six chapters, under the

titles, Introduction, Rural England—Social Life, Rural England—Agricultural, Town Life, the distribution of Wealth and Trade, Society—Wages—Profits. The remainder of the work deals especially with the history of labor and wages, great research having evidently been bestowed upon it, a general history of agriculture, and some particulars of the political history of England—in fact this point is not overlooked at any time—with an attempt to show that "the pauperism and degradation of the English laborers were the result of a series of Acts of Parliament and acts of government designed or adopted for the express purpose of compelling the laborer to work at the lowest rates of wages possible and which succeeded at last in effecting that purpose."

Chapters xviii and xix are devoted to a consideration of wages in the 19th century, as affected by the competition of capitalists, realxation of foreign tariffs, etc.; the present situation with its trades-unions, unequal distribution of wealth, its need of reforms in the land system and local taxes, the power and weakness of labor, etc. Chapter XX sets forth the remedies suggested to the author, among which it is needless to say protective tariff is not named.

The author was formerly Professor of Political Economy in King's College, and writes as an expert. His style when the matter allows is free and attractive, his views are those of Englishmen in general, which differ widely from some of the best thinkers and writers upon political economy in this country. No book of the day contains so great an array of facts, so pertinent to questions arising and certain to continue to arise as the United States increases in population, and the lines between land-owner and laborer are more distinctly drawn.

GEOLOGY AND MINERALOGY OF CHEROKEE COUNTY, KANSAS: By Erasmus Haworth, B. S. pp. 48, octavo.

We have received from Prof. Erasmus Haworth, of Penn College, Oskaloosa, Iowa, a forty-eight page pamphlet, entitled "A Contribution to the Geology of the Lead and Zinc Mining District of Cherokee Co., Kansas." This essay was prepared by Professor Haworth as a thesis to accompany his application to the faculty of Kansas University for the degree of Master of Science, and is a very full and complete geographical, geological and mineralogical description of the region in question. It also contains a discussion of the mode of ore occurence, the origin of chert and of the lead and zinc sulphides. It is a valuable contribution, scientifically and commercially, to the literature of Kansas geology, and would seem to possess especial value to the property owners and miners of Southwest Missouri and Southeastern Kansas. The author formerly resided in the region and has made its peculiarities a study for several years past. Professor Haworth desires us to say that he will send the pamphlet *gratis* to any one who will inclose him a two cent stamp for postage.

COUPON BONDS AND OTHER STORIES: By J. T. Trowbridge. 12mo., pp. 411. Lee & Shepard, Boston, 1884. For sale by M. H. Dickinson, $1.50.

This volume comprises ten of Mr. Trowbridge's characteristic stories, the best of which are "Coupon Bonds," which gives the title to the book, and "Fessenden's." The others, however, are all good, including "Madame Waldoborough's Carriage," "Archibald Blossom, Bachelor," "In the Ice," "Nancy Blynn's Lovers," "Mr. Blazay's Experience," "Preaching for Selwyn," "The Romance of a Glove," and "The Man Who Stole a Meeting-house."

Mr. Trowbridge has written a great many stories, in fact has been a well known novelist and story-writer for nearly forty years, and has lost none of his popularity even yet. He is a welcome contributor to *St. Nicholas*, and is highly regarded by all youthful readers. The book in question is handsomely put forth by the publishers, and the stories included will by no means lessen Mr. Trowbridge's credit.

OTHER PUBLICATIONS RECEIVED.

Magazine of American History, Mrs. M. J. Lamb, Editress, New York, June, 1884, 50 cents, $5.00 a year. Marietta College Alumni Memorial 1882–3, published by Alumni Association, Marietta, Ohio. Illusions, by James Sully, *Humboldt Library*, in two parts, price 15 cents. The Wonderland of the World, 1884, St. Paul, Minn. Catalogue of Marietta College 1883–4, I. W. Andrews, D. D. President. 18th Annual Catalogue of University of Kansas, 1883–4, J. A. Lippincott, LL.D., President. The *Kansas Medical Journal*, LaCygne, Kas., May, 1884, published by J. Milton Welch, $1.50 a year. The *Medical Index*, $2.00 per year, Kansas City, Mo., June, 1884. Report of the Kansas State Board of Agriculture, for month ending May 31, Wm. Simms, Secretary, Topeka, Kansas, 1884. Kansas, its Horticulture, Agriculture, Live Stock, Wm. Simms, Secretary, Topeka, Kansas. Fifth Annual Report of Executive Committee on Classical Studies at Athens; Boston, Mass., 1884. Proceedings of Boston Society of Natural History, Vol. 22, Part III, March, 1883, October, 1883, April, 1884. Remarks on Professor Newcomb's "Rejoinder," James Croll, LL.D., F. R. S. *American Meteorological Journal*, Vol. 1, No. 1, May, 1884, $3.00 a year, W. H. Burr, Detroit, Mich. Thermometer Exposure, H. A. Hazen, pp. 23. Reports of Professor of Agriculture, Kansas Agricultural College, 1884. Bulletin of Philosophical Society of Washington, Vol. 6, 1884, J. C. Welling, President. *Chicago Popular Monthly*, May, 1884, $1.50 a year. 16th and 17th Annual Report of the Peabody Museum, Vol. 3, No. 3–4, Cambridge, Mass., 1884. Report of the U. S. Fish Commission for 1881. Report of the Officers of the Smithsonian Institution for 1881. Third report of the U. S. Entomological Commission 1880-82. Wisconsin Historical Collections, vol. ix, 1880-82. Walls that Talk —Libby Prison, 25c. Mound Builders' Works near Newark, Ohio, Isaac Smucker, pp 10. Hand-Book of the St. Nicholas Agassiz Association.

BOOKS TO BE NOTICED.

Science Ladders, G. P. Putnam's Sons. What Is to be Done—A Hand-Book for the Nursery, Lee & Shepard, Boston. Catarrh, Sore Throat, and Hoarseness, G. P. Putnam's Sons. Seven Decades of the Union, (H. A. Wise) Randolph & English, Richmond, Va. Elements of Rhetoric and Composition, (D. J. Hill) Sheldon & Co. N. Y. Politics, (W. W. Crane & Bernard Moses) G. P. Putnam's Sons. Barbara Thayer, Lee & Shepard. Times of Linnæus (Topelius), Jansen, McClurg & Co. Life of Liszt (Nohl), Jansen, McClurg & Co.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

Seeding Attachment for Corn-Drills.—This improvement consists in attaching to a corn or seed planter of any description a sprochet chain having reversible lugs pivoted longitudinally to each link or every alternate link, as may be desired.

The lugs are pivoted to project at a right angle from the length of the chain links, and being reversible they may be thrown from one side to the other of the chain, in or out of gear, with teeth projecting upon the circumference of the seed plate, according to the distance apart it is desired to drop the seed. For instance, to drop very close, all the lugs are thrown in gear with the seed-plate, and, on the other hand, by reversing all of the lugs except one, seed may be planted such a distance apart as corresponds with the full length of the chain; while with a common check-rower or listing-drill, owing to their faulty construction, dropping can only be accomplished at comparatively shorter intervals.

The chain links are preferably constructed of malleable iron, and of the form previously described—that is, the lug-links have, near each end and projecting from the side opposite the driving-wheels, ears or lugs, between which the main lugs are pivoted.

To prevent sagging it is preferable to provide a support for the chain near the point where the lugs come in contact with the teeth of the seed-wheel, and for this purpose an anti-friction roller may be used.

This attachment may be arranged to operate any desired number of seed-plates, so that several rows will be planted at a single operation.

The inventor is Mr. Emile Lind, of Hiawatha, Kansas.

ENVELOPE OPENER AND PAPER-CUTTER.—This is a new and improved device of simple construction and consists of a blade or strip of metal, ivory, hard rubber, bone, or celluloid, having a fork at each end, all of the prongs being cutting edges.

The prongs are also slightly tapered toward the ends and are provided with rounded points.

An aperture is formed in the centre of the blade and this opening is surrounded on each side of the blade by a raised ring, the inner edge of which is beveled for forming two cavities for receiving the ball of the thumb while using the instrument.

To open an envelope, which is a very simple and speedy operation, one of the cutting prongs is passed under the flap and moved along the edge of the same.

Paper is cut in a similar manner, but the outer edges of the prongs are used.

The instrument is quite small and handy, and the aperture permits of hanging it on a hook when not in use, but the cutter was designed for carrying in the vest pocket, by Mr. C. E. Hochstetler of this city.

STEAM-ENGINE OR WATER-MOTOR.—This engine consists of a working-cylinder of the form termed "segmental," a piston fitted therein, a piston-rod bent to the proper circle and connected at each end to working-arms that oscillate up-upon a pin in the engine framing.

The cylinder is provided with combined induction and eduction balanced-valves operating between the faced surface of the cylinder covers and the ends of the cylinder.

The valves are operated by rods attached to a pin inserted in the boss of the working-arms and the whole is arranged to operate a crank by means of the shorter of three working-arms and a connecting rod, the arrangement sought for being to use a much shorter crank than is usually employed in engines and to obtain a leverage over the work also by the special form of the valves and direct ports, to give the freest admission and ejection to the steam or water.

In operation, steam or water being admittted to the cylinder through an induction port, the piston is driven thereby to the opposite end of the cylinder, meanwhile the valves have changed positions and the propelling fluid is admitted to the other side of the piston. The exhaust port of the starting end has liberated the contained steam or water while the exhaust valve of the opposite end is in a reverse position.

The eduction ports of this engine being situated at the extreme lower corner of the cylinder, it is especially adapted for use as an economical hydraulic engine and its compact form will allow of its being placed where other motors could not, because of the space occupied by them.

Mr. Gerritt S. Peppard of this city is the inventor.

THE KRAKATOA ERUPTION.

PROF. LOUIS G. CARPENTER.

AGRICULTURAL COLLEGE, LANSING, MICH., June 17, 1884.

EDITOR REVIEW.—Inclosed I send a small quantity of ashes from the celebrated Krakatoa eruption near Java last August. These were received through an acquaintance, of this State, who received them directly from a visiting friend, a sailor, who was on board the Karnek, at the time, near the Strait of Sunda.

The following is the account of the sailor, Mr. Becker, as repeated to me: "They were about two hundred miles from the island, sailing toward it, when about 10:30 A. M. they heard the tremendous report, and at about 3 o'clock these ashes began to fall, coming thicker and thicker until 4 o'clock the next morning. At 5 o'clock when they were falling the fastest, he could not see his hand before him. The deck of the ship was covered eighteen inches deep. They passed through the Strait of Sunda, the ship plowing through dead bodies as upon a great battle-field. Where the city of Anjer had stood with about 9,000 inhabitants, when they came there, there were fifteen fathoms of water standing over it and only two men had escaped alive, one an European minister, and the other a native. One-half of the island is sunk, and many small islands have arisen."

This corroborates the many accounts in the European magazines. But the feature of special interest in this account is the explosion, and the time of hearing it. If the report was "tremendous" at a distance of 200 miles it is not difficult to believe the account, which the great barometric disturbances do not render improbable, of those at much greater distances. If the time of hearing the explosion was local time then the explosion itself must have taken place at about 10h. 10m. local time, which closely agrees with the results reached by Gen. Strachey from the air-wave, and by Maj. Baird from the tidal-waves, the former giving 9h. 24m. and the latter 10h. 30m. as the time of the explosion.

PROCEEDINGS OF THE IOWA ACADEMY OF SCIENCE.

The Academy of Science met June 8th, President Fulton in the chair. The minutes of the last meeting were read and approved.

F. A. Mann, editor of the Halifax *Journal*, at Daytona, Florida, who is also a member of the Academy, sent the following contributions to the cabinet:

1. Some shells taken from the sub-soil of the "mammocks," or low, rich lands, formed by the action of the sea along the east coast of Florida.

2. Specimens of what is usually called "tree-coal," taken from a depth of two feet below the surface of the "mammocks," along the eastern coast of Florida.

3. A specimen of "coralline limestone," taken from an artesian well at a

depth of 158 feet below the surface, on the eastern coast of Florida. The stratum of limestone is twenty or more feet in thickness, and is termed "coralline limestone," because it is chiefly composed of disintegrated coral.

4. A specimen of marl taken from "mammocks" sub-soil on the east coast of Florida.

5. A specimen of coral from the outer reef off the coast, near Daytona, Florida, and brought in by the breakers.

6. A specimen of what is called coquina or soft stone, composed of the fragments of very small shells.

Accompanying these specimens was an interesting letter from Mr. Mann describing the coral reefs, which was read by the president. The Academy tendered Mr. Mann a vote of thanks for his contributions.

President Fulton then exhibited a specimen of copper ore found in Iowa, and read the following paper in connection:

"COPPER IN THE DRIFT OF IOWA."

I wish to exhibit to the Academy a very pure specimen of native copper ore found by Dr. John D. Parker, who resides ten miles southeast of Winterset, and near Peru post-office, in Madison County, Iowa. He found it while digging out a spring on his farm in that vicinity, at a depth of nearly six feet from the surface of the ground, and under circumstances which preclude any supposition that it may have been placed there recently, or since the settlement of the country by white people. The weight of this specimen is just ten ounces. On one side of it you will observe an irregular cavity, in which some small particles of quartz still adhere. Its general shape and appearance indicate that since it became detached from its original and native bed, it has been worn by the action of water, ice, and the various other forces which grind up the rocks into gravel and pebbles. Doubtless its original home was the Lake Superior copper region, but during that ancient time which geologists term the glacial epoch, or the age of ice, it was transported to the place where Dr. Parker found it by the same action which scattered the boulders over the prairies of Iowa, hundreds of miles from where they originally reposed "in place," in the far north. There have been numerous instances of the finding of native copper in connection with the drift of Iowa, in pieces varying from a few ounces to thirty pounds or more. A lump found by Col. W. S. Dungan, in Lucas County, Iowa, some years ago, weighed over thirty pounds. Wesley Redhead, Esq., Des Moines, is the owner of a fine specimen, weighing several pounds, which was found some years ago in the vicinity of Des Moines, and through his courtesy I also have the pleasure of exhibiting that specimen to the Academy. These specimens are in all respects similar to the native copper of the Lake Superior mines, as you may see by comparing them with the other specimens from my private cabinet, and which were taken directly from the mines a few years ago. Those mines were originally the home of all of them. We infer, from the finding of these fragments of copper in the drift of Iowa, that sometime during the glacial epoch the glacial current passed in a

southwesterly direction. The occasional finding of fragments of the common sulphide of lead in the drift of Iowa, in a southwesterly direction from the lead region about Dubuque, would indicate the same fact. Perhaps long subsequent to that part of the glacial epoch, during which these fragments of copper and lead were transported from the northeast, the glacial currents changed their course, and assumed the direction which brought about the present drainage system of Iowa—a general movement of those currents from nearly north to south. During that wonderful age, known in the geological calendar as the glacial epoch, the topographical conformation of the North American Continent was no doubt vastly different from what it is at the present time. That age of ice may have extended over many thousands of years, and until the latter part of it the Mississippi with its great valley did not exist. The present drainage of Iowa is the result of the later glacial currents, the currents which carried down in their flow the great granite and quartzite boulders now found so far "out of place" that we sometimes term them "lost rocks." As the climate gradually changed, through influences which astronomers explain, the glaciers slowly subsided, and these erratics were lodged as we find them, with their worn and rounded shapes and peculiar markings, still bearing the evidence of the forces to which they were subjected, just as the pebble you pick up on the beach of the Des Moines river shows by its oval and worn appearance the result of the action of the water. Every pebble, every grain of sand on the shores of our rivers was once a part of some stratum of rock in its proper geological position, but was displaced and carried away by the forces of nature, just as the fragments of copper were during the great ice age. These natural forces have never been suspended, for, in a modified degree, the same process is still going on. In our river valleys, with the constant alternations of heat and cold, dearth and flood, the rocks are still being ground into gravel and sand.

O. P. Pence, the treasurer, made a report stating that the society was out of debt and had nearly enough on hand to meet the next quarter's rent.

The following resolution was offered by T. G. Orwig and unanimously adopted:

"In view of the lamentable fact that much disease and suffering is occasioned by sewer gas and that all efforts heretofore made to economically and satisfactorily dispose of sewerage have failed, and

Whereas, Mr. Andrew Engle, of Metz, Iowa, has invented a method and apparatus for converting sewerage (urine, night soil and kitchen offal) into gas and charcoal that can be utilized for producing light and heat, and has demonstrated the merit of his invention by a practical test in the courthouse at Newton during the past month; therefore be it

Resolved, That we recognize the importance of Mr. Engle's scientific efforts in sanitary reform and respectfully request him in the interests of science to exhibit a model of his apparatus and explain the philosophy of his invention at our next monthly meeting, Tuesday evening, July 8."

Adopted.

The following officers were then elected for the ensuing year:

A. R. Fulton—President.

R. S. Miller—Vice President.

H. L. Chaffee—Recording Secretary.

Dr. W. M. Thomas—Corresponding Secretary.

O. P. Pence—Treasurer.

W. Bailey—Curator.

A. M. Forster—Librarian.

Directors—Geo. C. Baker, T. G. Orwig, R. S. Miller, A. R. Fulton, H. L. Chaffee.

The Academy adjourned to meet on the second Tuesday in July.

NEW RAILROAD LEGISLATION IN ENGLAND.

HON. GEO. C. PRATT, R. R. COMMISSIONER OF MISSOURI.

EDITOR KANSAS CITY REVIEW:—If you include "transportation" among the industries coming within the scope of your REVIEW, you may possibly think this article from the *Railroad Gazette* worth re-publication; as being calculated to awaken the attention of thinking men to this subject. There is a similarity between Missouri and English legislation in that the same hesitancy to give the Commissioners entire control over rates has been exhibited in both.

Respectfully yours,

GEO. C. PRATT.

A bill has recently been introduced into Parliament making important changes in the powers of the English Railway Commission. It is by no means certain to pass at this session; but whether it passes or not, it foreshadows the course which English railroad legislation is likely to take in the immediate future. It is no mere haphazard proposal, like so many of the bills brought before Congress. It is officially introduced by Mr. Chamberlain, President of the Board of Trade, and is based upon the report of a strong Parliamentary Committee which had spent two years in studying the questions at issue. It may be taken as expressing the deliberate views of a number of leading Englishmen of both parties.

It is now eleven years since the English Railway Commission was established. It was a new piece of machinery for carrying out an old law. The act of 1854 defined the relations between the railroads and the public. But it had remained to a great extent a dead letter. Cases constantly arose under it of which the courts would not and could not take cognizance. Others involved great delay and expense to the complainants; so great as to deter men from having recourse to the courts when the law was plainly on their side. To meet these difficulties the Railway Commission was established. It was intended to enforce those parts of the act of 1854 which the courts could not enforce, and to

secure quick comparatively cheap relief to those who could not afford the expenses of a long lawsuit.

It was avowedly an experiment—originally established for five years, renewed only for still shorter periods. It is neither a complete success nor a decided failure. Its best work is its indirect work. The fact that such a tribunal is there prevents a great many disputes from arising, and acts as a check upon arbitrary power. But the evidence before the committee of 1881–82 showed that its direct results left much to be desired. It was only empowered to deal with cases under the act of 1854, so that it often suffered for want of jurisdiction. It could not enforce decrees of *mandamus*. It could not prevent appeals from being taken to a superior court, so that if the railroad companies chose to contest the case it cost the complainant about as much time and money under the new system as under the old. The Commission suffered because its powers were so ill-defined. Some of these difficulties it is now proposed to remove. The effect of Mr. Chamberlain's bill, if adopted, would be to bring the powers of the Commissioners much nearer to those of an ordinary court of law. It gives them jurisdiction under the special railroad acts as well as under the general act of 1854. It enables them to enforce their authority like any other court. For the roundabout modes of procedure hitherto in use it substitutes an explicit right of appeal under some restrictions which are perhaps more apparent than real. Appeal is granted only in those cases where it shall be specially admitted either by the commissioners themselves or by a court of appeal. Of course the last exception makes the whole restriction amount to very little, though the railroad companies object strenuously that their right to appeal is too much restricted.

It is proposed to make the Commission permanent. No further change is to be made in its constitution. Many of the railroad men would have preferred a Commission composed entirely of lawyers, but the parliamentary committee considered this as out of the question. Provision is made by Mr. Chamberlain's bill for the occasional employment of technical assistance (assessors) in cases where it may be demanded.

The matter of direct control over rates is not settled by the proposed bill, and remains pretty much where it was before. On one point there is a curious compromise. The State has always exercised a certain control over the mileage rates of the English railroads, but the roads have claimed the right to make an arbitrary terminal charge—not merely the "handling terminals," for loading and unloading, but the "station terminals," for use of sidings, expense of signal men, interest on station buildings, etc. Under this head of station terminals the roads have claimed the right to charge what they pleased. The Commissioners have, in a very recent decision, denied their right to make any charge at all, holding that the legal mileage rates were intended to cover everything but "handling terminals." The present bill proposes that reasonable station terminals be granted to those roads (and only those) which submit a revised classification of goods under which their mileage rates may be regulated.

These are but a few among many provisions; but they are the only ones

fecting the Railway Commission which are likely to be contested. At present ey seem to exasperate both parties. This is because they parcel off a piece of isputed ground where each party formerly claimed the whole. The railroad men held that there was really no occasion for the Commissioners; the shippers held that they ought to be allowed to settle pretty much everything. Therefore the railroad men are dissatisfied to see the Commission made permanent and given independent power; while the shippers are dissatisfied to see that power limited by the right of appeal, or the allowance of station terminals.

There can be no doubt that the bill offers some great advantages. It settles many points which have hitherto been at loose ends. It substitutes definite and efficient powers for vague ones. The one serious danger is that it may lead to a determined attempt on the part of the Commissioners to base rates upon cost of service instead of value of service. They have tried to do so in many cases which have come before them in the past. There is some reason to fear that they may, with their increased powers, pursue the same policy on a larger scale in the future.

CHOLERA—THE SAFEGUARDS OF AMERICA.

Dr. John B. Hamilton, Surgeon-General of the Marine Hospital Service, expresses the following opinion as to the possible danger of the introduction of Asiatic cholera into the United States, and of the means taken to keep it away.

He said that the United States kept up three quarantine stations. Of these, one is at Ship Island, near the mouth of the Mississippi, which is for all points on the coast of the Gulf of Mexico. The steamer Day Dream, which formerly belonged to the National Board of Health, is attached to this station, and there is also a steam launch for boarding vessels and removing sick to hospital. Surgeon Robert D. Murray, who has become noted in connection with the yellow fever epidemics, is in charge.

The second station is at Sapelo Sound, on the coast of Georgia, and is the quarantine for all ports between Key West and North Carolina. Acting Assistant Surgeon George H. Stone is in charge, having the sloop Gypsy as a tender and boarding vessel, and has an assistant at the hospital on the island.

The third station is the Cape Charles quarantine grounds, situated on Fisherman's Island, just inside of Cape Charles, and is the quarantine for Norfolk, Newport News, Richmond, Fort Monroe, Fredricksburg, Alexandria, and Washington, and all other ports on the Chesapeake or its tributaries, except Baltimore, which is in charge of the health officials there. The boarding vessel there is the steamer John M. Woodworth, and there are two steam launches. The officer in charge is Passed Assistant Surgeon Fairfax Irwin, and Dr. Hubbard remains at the island, where a temporary hospital building seventy feet in length has recently been completed.

The large seaports—Philadelphia, New York, and Boston—are attended to

by the local health officers, and it is believed the precautions are sufficient and thorough.

Quarantine at Ship Island, for the Gulf ports, exists throughout the whole year, while at Sapelo Sound and Cape Charles it begins May 1st each year, and continues until December.

Being asked if he had heard of the prevalence of cholera abroad before the publication of the press dispatches yesterday morning, Dr. Hamilton said he had not before heard of its reaching the continent of Europe, but he knew that precautions had been taken as long ago as last year on account of its prevalence in Egypt, and had been advised that quarantine against Egypt had been declared at Malta over two months ago.

The continuance of the disease at Calcutta throughout the winter was known, and interesting reports had been made by Surgeon Major McLeod, of the British army, on the subject. It is still in doubt whether the cholera, which made such ravages at Damietta, Egypt, last year, was brought there from Calcutta by the Indian troops. The English officials alleged that the disease was caused by the large number of dead and decaying animals in that neighborhood, but recent researches prove that while disease resulted from that cause it did not produce the cholera.

Official reports received here through the State department from Calcutta show that the cholera has been increasing there steadily for the past four months, and also that it is prevalent on the eastern coast of China. This latter fact was known months before its publication in yesterday's dispatches.

The commission sent out last year by France, under the leadership of Pasteur, and by Germany, under Dr. Koch, determined the active principle of the germ, "bacillus," of cholera, but vitally disagreed as to its location. The French commission reported the bacillus to be present in the blood, while the Germans declared that it was located in the intestines.

Much controversy was excited by these conflicting theories for a time, but Koch carried his commission to India, where the same result was found, and, further, he discovered the presence of the same bacillus as those found before in the stricken cities in Egypt, in the water-tanks at Calcutta. This solution of the subject is now generally accepted by the scientific world, and it has a distinct bearing on the means by which the dread disease is propagated as well as points directly to the means of stamping out and preventing it spread. Dr. Koch, however, was unable to obtain any results from his experiments in inoculating the lower animals, but now Surgeon Major McLeod reports that another medical officer in India (Dr. Richards) had obtained definite results by poisoning the common hog with the evacuations from cholera patients

The treatment of cholera patients at quarantine, based on the discoveries of Dr. Koch, will be to isolate the case as soon as the disease appears, and have all bedding and the evacuations of the patient destroyed by fire. This course is necessary to prevent the spread of the disease.

If the cholera spreads in France inspectors will be stationed at each of the

pal foreign seaports to examine all steerage passengers and crews, and in-
ons will be given collectors of customs to prevent the landing of any bag-
elonging to passengers or men who have died during the passage at sea
ny disease, as, although the death may be reported from something else,
is a possibility of the death having been from cholera.—*Nat. Republican.*

EDITORIAL NOTES.

F. CHAS. H. STERNBERG, of Lawrence,
, and Mr. W. W. Russ, of the Kansas
niversity, are now out upon a geolog-
cursion, collecting fossils for Prof. O.
rsh in the northwestern counties of
tate. In Ottawa County they were
te enough to secure the head and cer-
ertebræ of a Saurian whose extreme
judging by the dimensions of the
fty inches, must have been over sixty
The remainder of the skeleton was
tlessly destroyed by the quarrymen
scovered it.

. J. G. PORTER, of the United States
Survey, Washington, D. C., has been
Astronomer of the Observatory of
iversity of Cincinnati, Ohio, to suc-
rof. Ormond Stone, who has taken a
position at the University of Vir-

EDWIN HARRISON and Major F. F.
, of the Committee on Science and Ed-
, ask in behalf of the St. Louis Ex-
Association the cordial co-operation
who can assist them in making a dis-
such articles as can be classed as il-
ons of any of the many branches of
ve department. From inventors and
cturers of apparatus and instruments
ruction and scientific investigation,
pe to receive such a display as will
itable to the exhibition, and at the
me be of service both to the exhibitors
public. From Colleges, Industrial,
hnic, Manual Training and other
they solicit exhibits of the work of students and scholars in every department of their respective courses In the great field of the natural sciences everything will be acceptable that will serve as an illustration of any department; collections, specimens, models and drawings will be welcome.

ON June 2d Dr. A. P. Lankford died at Lexington, Mo., at the age of forty-seven years. He was formerly engaged in the practice of medicine in this city, and filled the chair of surgery in the Kansas City Medical College. Subsequently he was selected to fill the same position in the Missouri Medical College at St. Louis, which he did most acceptably for about ten years, when his health gave way and he returned home to die at his father's house. Dr. Lankford was an able man and skillful surgeon, and was held in high estimation by all of his associates and acquaintances.

IN the catalogue of the Missouri University, for 1883-4, we find a valuable article by Prof. G. C. Broadhead upon the "Relation of the Soils of Missouri to Geology," also his report of work done in re-arranging and labeling the fossils and mineral specimens in the University Museum.

PROF. S. H. TROWBRIDGE, of Glasgow, Mo., writes: "I am pained to know that the REVIEW is still a financial weight, instead of the grand success it so richly deserves to be in your hands. It would be a calamity to many friends of popular science and improvment if its publication should cease."

PROF. E. D. COPE left yesterday morning for the East. The professor was very enthusiastic in regard to the Kansas City Academy of Science, which he said was one of the most active associations of its kind in the West. He also spoke in the most flattering terms of the Kansas City REVIEW OF SCIENCE AND INDUSTRY, edited by Col. T. S. Case, and said that it had done more for scientific and industrial progress than any other periodical west of the Alleghany Mountains. —*Kansas City Journal.*

WE have received the 42d Catalogue of the Missouri University. It is a handsome and voluminous document, illustrated with a cut of the main building as it will appear when the present work of enlarging is completed, and several other engravings of buildings, etc. We learn from it that the faculty consists of thirty-four professors, lecturers and instructors, that the means of illustration and instruction in the various departments are ample and of the most modern kinds, and that the number of students for the current year was 573, of whom 517 were from this State and the remainder represented sixteen States and Territories. The standard is high and the curriculum extensive and complete.

PROF. F. E. NIPHER, the noted physicist at Washington University, St. Louis, says in a recent letter: "I send payment for Vol VII, also for an additional year. I am sorry that I have not had time to write anything for the REVIEW lately, for I think it should be sustained, and our people in the West should be educated up to as high an appreciation of scientific work as possible and all of us should aid you in it."

THE Fifteenth Annual Commencement of the Kansas State Agricultural College took place June 8th to 11th inclusive. The annual examinations, conducted orally and in writing, were held in the several class-rooms and shops from 8:30 A. M. to 12:10 P. M., June 9th and 10th. The Baccalaureate Sermon and the annual addresses were given in the College Chapel where the Undergraduates Exhibition and the exercises of the graduating class were also held. Visitors were welcomed to all of these exercises, and given opportunities for examining the College in all its departments,—museums, laboratories, the farm and its stock and crops, orchards and forest plantations. The exercises were as follows: Sunday, June 8th, 4 P. M.—Baccalaureate Sermon by the President Rev. Geo. T. Fairchild, D. D.; Monday, June 9th, 8 P. M.—Undergraduates' Exhibition by members of the third-year class in charge of Prof. E. M. Shelton; Tuesday, June 10th, 8 P. M.—Annual Address by Hon. Geo. R. Peck, of Topeka. On Commencement Day, Wednesday, June 11th, 10 A. M. —Exercises of the Graduating class; 5 P. M. —Address before the Alumni Association by W. D. Gilbert, Class of '74; 8 P. M.—Alumni Reunion. Everything passed off in the most creditable manner. The degree of B. A. was conferred upon seventeen graduates, who were addressed by Hon. F. D. Coburn, of Wyandotte.

THE Missouri Teachers' Convention met at Sweet Springs on the 24th, 25th and 26th of June. There was a large attendance of the prominent educators of the State and the exercises were of an interesting character and of a higher standard than ordinary. We expect in the next issue of the REVIEW to publish some of the best papers that were read.

OUR old friend Prof. John D. Parker, now Chaplain in the U. S. Army, in addition to his military duties and true to his literary tastes, finds time to prepare and deliver an occasional lecture. He is now ready to receive proposals for courses of lectures upon meteorology and archæology, and can be addressed at Fort Hays, Kansas.

THE National Teachers' Association meets at Madison, Wisconsin, July 10th to 18th, and the indications are that there will be a very large number avail themselves of the many inducements offered to be present.

H. S. PRITCHETT, late of the U. S.)bservatory, and now Astronomer at gton University, St. Louis, very en- agly writes: "I can well understand u may sometimes feel discouraged work you have been carrying on. en you compare the REVIEW, both as er of subscribers and the character ticles, with the various other efforts the past ten years (chiefly in eastern ou have every reason to feel proud I consider that you have done more dvancement of science in the West u started the REVIEW than any oth- nan. You will find all friends of ready to admit this."

EMS FROM PERIODICALS.

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ibers to the REVIEW *can be furnished this office with all the best magazines of ntry and Europe, at a discount of from per cent off the retail price.*

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y person remitting to us the annual sub- price of any three of the prominent liter- ientific magazines of the United States, omptly furnish the same, and the KANSAS EVIEW, *besides, without additional cost, ear.*

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ere much gratified to find the follow- he *Popular Science Monthly* for June: its May number the KANSAS CITY OF SCIENCE AND INDUSTRY begins th year. The REVIEW is doing an t work in stimulating an interest in in the rapidly growing country west lississippi. But very few of its arti- solely of local interest: a wide range ces is represented in its pages, while ctures and the arts based upon science, g education, are by no means neg-

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immemorial institution of trial by hich for centuries has been regarded f the most essential rights of the cit- d one of the most effective barriers absolute power, is itself on trial to- day, and is required to show cause why it should not be discarded and a more effectual method of administering justice substituted for it, or at least why it should not be re- formed so as to yield more satisfactory re- sults. Some suggestions for the improve- ment of the existing jury system, presented by Judge Robert C. Pitman in the *North American Review* for July, under the title of "Juries and Jurymen," should, in view of recent notorious miscarriages of justice, re- ceive the serious consideration of every thoughtful citizen. "American Economics," by Prof. VanBuren Denslow, is a lucid and forcible exposition of the grounds upon which the protection theory of national economy is based. Judge Noah Davis writes of "Mar- riage and Divorce;" Dr. P. Bender, whose subject is "The Annexation of Canada," sets forth the advantages likely to accrue to the United States from the absorption of the Canadian provinces; Prof. D. McG. Means, in an argument against "Government Tele- graphy," subjects the management of the Post Office to a most searching criticism; Charles T. Congdon writes of "Private Ven- geance;" and, finally, there is a symposium on the "Future of the Negro," by Senator Z. B. Vance, Frederick Douglass, Joel Chand- ler Harris, Senator John T. Morgan, Prof. Richard T. Greener, Gen. S. C. Armstrong, Oliver Johnson, and others.

FOR those of our readers who wish a most valuable and exhaustive discussion and de- scription of "Emblematic Mounds" we can do no better than refer them to Rev. Dr. Peet's articles in the *American Antiquarian.* Dr. Peet has made these mounds a personal, laborious and discriminative study, and is probably one of the best American authori- ties upon the subject.

THE *Popular Science Monthly* presents the following attractive table of contents for July: The Great Political Superstition, by Herbert Spencer; Colorado for Invalids, by Samuel A. Fisk, M. D.; The New Theology, by Rev. George G. Lyon; Our Debt to Insects, by Grant Allen; The Fruits of Manual Train-

ing, by Prof. C. M. Woodward, Ph. D.; Are Science and Art Antagonistic? by M. M. Guyau; The Vo'canic Eruption of Krakatau, (Illustrated); The Prevention of Hydrophobia, by M. Louis Pasteur; The Morality of Happiness, by Thomas Foster; Diseases of Plants, by D. P. Penhallow; Adaptation to Climate, by Dr. A. Berghaus; Glasgow's Bandy-Legged Children, by George Hay, M. D., (Illustrated); Sketch of Averroës, by George Jackson Fisher, M. D., (With Portrait); Editor's Table; The Survival of Political Superstition—President Eliot on Liberal Education; Literary Notices; Popular Miscellany; Notes.

Science continues to maintain the high standard of excellence aimed at by its accomplished editor, and may now be regarded as firmly established. Weekly, $5.00.

THE first number of the *American Meteorological Journal*, published by Mr. Burr, of Detroit, and edited by Professor M. H. Harrington, at Michigan University, Ann Arbor, Mich., has been received. It is neat in appearance and comprehensive in plan. Doubtless it will succeed, being the only strictly meteorological journal in the country.

THE *Art Interchange* of June 19 contained designs for fish dish and a half dozen fish plates. These designs show marine plants, fishes and shells arranged in a charmingly decorative way. A design in color for sofa pillow decoration, by the Boston Society of Decorative Art, is also given. A unique design of oak leaves and acorns, for larger dishes of dinner service, and an exquisite woodland scene, "The Ruined Abbey," by LaLanne, are also to be found in this issue. In Decorative Notes is given some interesting information as to novelties in pottery, porcelain, glassware, vases, lamps, screens, yacht pillows, photograph frames, sachets, birch bark calendars. In Notes and Queries department questions are answered relative to pastel painting, Kensington painting, siccatif de Harlem and siccatif de Courtray, decorative arrangement of peacock feathers, embroidery, the celebrated Duran palette, sketching on linen and brass work. Published by William Whitlock, 140 Nassau Street, New York. $3.00.

Harper's Magazine frequently hits a topic of the day, in its illustrated articles, with notable timeliness. The leading paper of the July number will be on "The Nile," a subject in which there is just now a good deal of interest all over the world, with illustrations by Sir Frederick Leighton, P. R. A., and from other sources. The timeliness is all the more remarkable when it is remembered that it is largely a matter of editorial prognostication, since the illustrated sheets of the *Magazine* are often made up by the editor nearly six months in advance of the date of the *Magazine*.

THE *Dial*, a monthly journal of current literature, published by Jansen, McClurg & Co., Chicago, $1.50 per year, began its fifth year in May with new and specially selected type throughout, and the promise of even greater beauty of execution than that in which it already is known to excel most journals of its class. It will continue its distinctive and approved features of exhaustive review articles by special writers, critical notices of important books, notes on interesting literary events, and other features completing its scope as a trustworthy and elegant journal of current literature.

WE have received the January-April volume of the Proceedings of the Philadelphia Academy of Sciences, edited by Edward J. Nolan, M. D. It comprises 130 pp. with articles, more or less condensed, by such able and distinguished members and contributors as Prof. Joseph Leidy, M. D., Profs. Lewis H. Carvill, Asa Gray, Thomas Meehan, F. W. Putnam, David S. Jordan, Angelo Heilprin, Rev. H. C. McCook and others. This is one of the oldest scientific associations in this country, and has published some thirty-five volumes of its proceedings, besides many other works of high scientific merit. Application for these works may be made to the editor.

THE Franco-American Committee will deliver the Bartholdi Statue of Liberty Enlightening the World to United States Minister Morton, July 8th, in the presence of Prime Minister Ferry and a delegate representing President Grevy. The statue will be shipped to New York late in July.

ABOUT July 15th Messrs. Franc M. Paul and Albert B. Tavel will commence the publication of a semi-monthly trade journal under the title of *The Southern Miner and Manufacturer*. It will be devoted mainly to the development of the immense and varied resources of the South and their manufacture at home. It will be published at Nashville, Tennessee, on the 1st and 15th of each month. $2.00 per annum.

THE new models of the carriage and pontoons of the Eads Ship Railway have started for London. Nearly all the capital for the enterprise is being subscribed in that city. Chief Engineer Corthell says 100 men are at work and that the first half mile of track has been completed. This, with the river course, which admits three of the largest ships abreast, completes twenty-five and a half miles of the Tehuantepec route. The new pontoon system of raising vessels from the water upon the railway carriage is to be substituted for the hydraulic system first contemplated. It was conceived by London engineers and adopted by Eads, and will raise a ship out of water and upon the carriage in twenty minutes.

SIR W. THOMPSON, the eminent physicist, recently delivered a lecture before the Midland Institute on the "Six Gateways of Knowledge," using the word "six" as a supposed improvement on the old phrase, "five gateways of knowledge." The sixth or additional gateway was the sense of heat as distinguished from the sense of touch; but in reality the sense of heat is probably only another function of the sense of touch, and there is no absolute need to add another to the conventional five senses. Sir William also suggested that there was probably a "magnetic sense," that is to say, he believed that some people might be found who could tell the presence of magnetism acting on their person.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

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SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VIII. AUGUST, 1884. NO. 4.

GEOGRAPHY.

ARCTIC CORPS OF EXPLORERS.

JOHN D. PARKER, U. S. A.

For centuries arctic exploration has elicited a wide-spread interest among many civilized nations. Icelanders, under a Norwegian captain, in the year 1000, discovered the American Continent, and sailed as far south as the coast of Massachusetts, which they named Vinland. Colonies were established by them on the Greenland coast, numerous churches planted, and profitable fisheries maintained for many years. Monuments were erected by this exploring party, on an island in Baffin Bay, where they were discovered in 1824. Since the early colonies of Icelanders and Northmen, in Greenland and Spitzbergen, perished, nearly all European nations, as well as Americans, have been more or less engaged in arctic exploration.

Arctic discovery has been prosecuted with vigor for several reasons. A mystery has hung over the polar regions which affects many departments of science. Evidence accumulates which indicates the existence of a vast polar sea. One branch of the Gulf Stream, composed of warm tropical waters, is known to set as an under-current into the Arctic Ocean, while a surface current flows in an opposite direction into the Atlantic Ocean. Immense icebergs have been seen drifting rapidly to the north against a strong surface-current flowing southward. These icebergs were evidently driven by a powerful under-current, as they extend in some instances two hundred feet above the surface of the sea,

and, if they are parallelopipeds, their depth below the surface would be seven times greater than their height above it.

Whales have been harpooned on the eastern side of the American Continent, in high latitudes, and have been captured, in some instances after a very short time had elapsed, on the western side, with the harpoons still in them, bearing the stamp of the ship, which is an indication of a northwest passage. The right whale is never found in tropical waters, and these harpooned whales could not, therefore, have passed around Cape Horn, or the Cape of Good Hope. Lieutenant DeHaven, who commanded the American expedition, in search of Sir John Franklin, when he arrived in high northern latitudes, saw far to the north a "water sky," which always indicates an open sea. Agassiz and other naturalists have noted the fact of the disappearance of immense numbers of whales into waters of very high latitudes just before the ocean was frozen over. As the whale is an air-breathing animal, and cannot live under the ice, its immigration northward must indicate an open polar sea. Water fowl have also been seen flying far to the north, as if they were seeking an open polar sea.

All of these indications prepared the world for the report which Dr. Kane brought back of an open polar sea north of the eighty-second parallel of latitude. After passing an ice barrier nearly one hundred miles wide where the spirit thermometer indicated a temperature of sixty degrees below zero, he came to the shores of an iceless sea, which extended toward the pole, in an unbroken sheet of water, as far as the eye could reach. As Dr. Kane approached the open water, he wrote: "We see its deep indigo horizon, and hear its roar against the icy beach. Its scent is in our nostrils and our hearts." Here the tides ebbed and flowed, and the waves dashed on the shore with the swell of a boundless sea. Probably the area of this polar sea may be shifted more or less by varying seasons, but it doubtless always remains open with a mildness of climate that would allow of human habitation.

Arctic discovery has been fruitful in various directions. It has enlarged our knowledge of the geography of the globe, and enabled us to construct our maps with much greater accuracy. Something has been gained in regard to the fauna and flora of the north polar region. We have been able to locate with some precision the magnetic pole, which is not without its value to navigation. Meteorology has received some contributions, and the aurora borealis has been studied in its native home. Some light has been thrown upon arctic geological formations, and our knowledge of the sea and its inhabitants has been enlarged. Ethnology has received valuable contributions by a comparative study of the various tribes of the Innuits, the raw fish-eaters, who are scattered over Greenland, Labrador, and the shores of the Arctic Ocean, and extend down the Pacific Coast as far as the Peninsula of Alaska, and also a portion of the adjacent Asiatic Coast. The missions established by the Moravians among the Innuits, about the middle of the last century, have been fruitful in important results to that superstitious people.

We should not be insensible to the benefits derived from arctic discoveries

in various directions. Knowledge is priceless, and science teaches that no fact is so insignificant as to be overlooked. But the results flowing from arctic discoveries have been purchased at a great sacrifice. Many valuable lives have been lost in the ice fields and floes of northern seas, great suffering have been endured, and an untold amount of property has been lavished on the expeditions. During the last eight centuries, probably not less than one hundred expeditions have been fitted out by national patronage, and private munificence. The larger portion have sailed in well equipped ships, while others have traversed the country on sledges. Science and art have been exhausted in fitting out these expeditions in the most elaborate manner, and nothing that could contribute to the ultimate success of the expeditions has been overlooked or wanting. The navies of the world have been stripped of their most sea-worthy vessels, and every appliance known to navigation has been supplied. Skill has been employed in the preparation of food for long voyages while ships might be locked in the ice. Cairns have been constructed in various places to preserve the records of lost expeditions, and caches located so that ship-wrecked mariners might not perish. These expeditions have been manned by the most distinguished navigators of all countries, and accompanied by experts in every department of natural science. We recognize the highest and most versatile talent in such men as the Cabots, Sir Hugh Willoughby, Martin Frobisher, John Davis, Henry Hudson, Von Wrangell, Lord Mulgrave, Captain Cook, Sir Alexander Mackenzie, Sir John Ross, Lieutenant Parry, Sir John Franklin, William Baffin, Sir George Back, Dr. King, Dr. Rae, Captain Penny, Lieutenant DeHaven, Lieutenant McClintock, Dr. Kane, Dr. Hayes, Captain Hall, Lieutenant DeLong, Captain Nares, Nordenksjöld, Lieutenant Frederick Schwatka, and many others. Their ships have vexed the Arctic seas, encountered icebergs, wrestled with floes, drifted in the frozen ice, and their sledges have tracked the frozen fields of the north, or been covered with accumulating drifts. Exploring parties have been days without food, eating their old shoes and scraps of leather, subsisting at last on rock tripe and mosses, sleeping with a single blanket and deer-skins, with the spirit thermometer 57° below zero, and have dragged their canoes and sledges over the snow until they have dropped down from sheer exhaustion, and multitudes have left their bones to bleach under the snows of Arctic lands.

When Arctic exploration seemed destined to prove a comparative failure, Capt. H. W. Howgate proposed to establish a colony of fifty persons, on the shores of Lady Franklin Bay, where they would be supplied with fuel from a seam of coal lately discovered. This Arctic colony was to be provisioned for three years, and another smaller colony was to be established at Cape Union about ninety miles farther north, and the two colonies connected by telegraph. The world is now witnessing an expedition sent out to relieve Lieutenant Greely whose safety is problematical.[1]

Amidst such unparalleled hardships and sufferings, on the part of Arctic explorers, of nearly all civilized nations, we cannot wonder that the world is becoming a little weary of Arctic exploration, and many are asking, "Why is all

1 Written before the news of Lieut. Greely's rescue had been received.—[ED. REVIEW.

this loss of life and waste of treasure?" In view of these things, it is the purpose of this paper to propose a new plan of Arctic exploration, which will not endanger life to any considerable extent, or cost much public patronage, but will perhaps secure more important results than have hitherto been obtainable. It is proposed that our Government, with the coöperation, if possible, of other civilized nations, turn over this whole business of Arctic exploration to an Arctic corps of explorers, composed of native Innuits, who should be secured, educated and employed by the Government, under the command of an American naval officer, in the following manner: Let our Government secure through the auspices of the Moravian missionaries, laboring among the Innuits, twenty or more of the young men of that people who have arrived at the age of eighteen or twenty years. The age fixed upon should be the time of life when their physical nature has become accustomed to the rigors of an Arctic climate, while the mind is still in a receptive condition. Sufficient inducements should be offered these young men to become cadets at the Naval Academy, where they should be instructed in the English language, and given a regular naval education. If difficulty is experienced in obtaining the whole corps of Innuits at first, secure one and educate him, and the way would doubtless be opened to obtain as many Innuits as were wanted, upon whom would gradually dawn the possibilities of a new life. These native Innuits, as soon as they could comprehend the project, would undoubtedly respond with alacrity, to the universal call, to explore their native country, and to dissolve the mists which have hung over the polar regions so many centuries. Let these young men be employed in the navy, as the Arctic Corps of Explorers, and put under the command of some naval officer, of hardy constitution, like Captain Hall. By adopting as far as necessary methods of living employed by the Innuits, supplemented by improvements offered by civilization, such a corps would be enabled to prosecute Arctic exploration under the most favorable auspices possible. They would possess the personal qualities demanded by the rigors of an Arctic climate, be familiar with the methods of living adopted by the natives, supplemented by improved methods, and possess for their work of exploration the knowledge and equipments of modern scientific research. Let the Government build a vessel adapted to Arctic exploration, and furnish it with all the necessary equipments. Sledges could be used in high latitudes, and the work could be carried on systematically over a period of years, long enough to solve all the questions of the Arctic regions which have been studied at such a disadvantage and sacrifice of life and property, by nearly all civilized nations, for the last eight centuries. Possibly the ice barrier surrounding the polar sea could be passed, and a vessel launched on that mysterious ocean, whose tides have ever beaten on unknown shores, where science would reap an abundant harvest, whose circles of facts have ever been broken in polar seas. The captain, the prow of whose proud ship plowed the waves of the Arctic sea beneath the very pole, would have unlocked the mysteries of this unknown region, and brought some compensation to the nations whose efforts have been baffled for centuries, and whose mariners lie unburied in many Arctic lands. Other

enlightened nations might desire to share in the expenses of such an exploration, conducted on natural and common sense principles, and be entitled to reap mutual advantages.

The Arctic corps of explorers could be kept full, by enlisting and training other young Innuits, as the demands of the service might require. When the mysteries which have hung over the north pole so many centuries have been solved, and the possibilities of that unknown region been determined and utilized for civilization, the Arctic corps of explorers could be transformed into an Antarctic corps of explorers, who could apply their skilled powers in solving the mysteries of the south polar region which are as great perhaps as those of the opposite pole.

The Innuits, as a people, possess the natural qualities necessary for Arctic exploration. They are a very hardy race, and nature has given them peculiar qualities for enduring the rigors of an Arctic climate. Crantz describes those living in Greenland as "small but well proportioned, broad shouldered, generally less than five feet high, with high cheek bones, flat faces, small, lusterless black eyes, round cheeks, small flat noses, small round mouths, long, straight, coal-black hair, large heads and limbs, and small, soft hands and feet." They are a hardy, active, industrious and ingenious race, and show great skill in the construction of their boats and sledges, weapons and utensils. Their dwellings are located near the shore, as they subsist mostly on raw fish, and are constructed of snow, ice or stone, cemented by turf, and covered by a flat roof of wood or turf. Frobisher and Parry describe some of their houses which were built of the bones of whales and walruses. In the preparation of their dress, which consists principally of furs, they exhibit a degree of ingenuity greater than that of the most skillful furrier. Their small boat for men is remarkable for its speed and beauty, and the Innuit has such control over it that he can defy the storms of ocean, and has such daring that he does not hesitate in his *kayak* to approach and give battle to the polar bear, or the monsters of Arctic seas. They hunt with bows and arrows, spears and slings, carve on ivory or walrus tusks with much skill, and are scrupulously honest among themselves. There can be no doubt, that under the influence of modern civilization, these Innuits could be educated and inspired to execute polar exploration at a minimum cost of life and treasure, and a maximum of all possible results desired in modern times. Such a corps of Arctic explorers, skilled in the methods and results of modern scientific research, and imbued with the spirit of the nineteenth century, would not be without their influence in diffusing better ideas among the various tribes of Innuits scattered through the Arctic regions, and give them the pulses of a new life.

This new plan for Arctic exploration is offered, with some degree of hesitancy, for the consideration of Arctic explorers, in the hope that although some objections seem to lie against it, still it may contain the germ of a new plan of exploration which may be developed in the skillful hands of explorers, to accomplish all desirable results, and still save the further great loss of life and treasure, which nearly all civilized nations have suffered for more than eight hundred years.

RESCUE OF THE GREELY EXPEDITION.

COMPILED BY THE EDITOR.

On July 17th the thrilling news was received at the War Department in Washington City, D. C., of the rescue on June 22d of the survivors of the Greely expedition which left the United States in 1881, and in regard to whose fate the most lively apprehensions have existed for the past year or more. This news was, however, extremely depressing, since out of the twenty-five persons comprising the original party only seven were found alive, one of whom (Ellison), died soon after the discovery, from the effects of an operation necessitated by his disabled condition.

The following are the dispatches received at the War Department:

ST. JOHNS, N. F. 9 A. M., July 17th.

To HON. WM. E. CHANDLER, Secretary of the Navy, Washington:

The Thetis, Bear and Loch Garry arrived here to-day from West Greenland, all hands well. They separated from the Alert 150 miles north during a gale at 9 P. M., June 22d, five miles off Cape Sabine, in Smith's Sound. The Thetis and Bear rescued alive Lieut. A. W. Greely, Sergeant Brainard, Sergeant Fredericks, Sergeant Long, Hospital Steward Beiderback, Private Connell and Sergeant Ellison, the only survivors of the Lady Franklin Bay expedition. Sergeant Ellison had lost both hands and feet by frost bite, and died July 6th, at God Haven, three days after amputation, which had become imperative. Seventeen of the twenty-five persons composing the expedition perished by starvation at the point where they were found. One was drowned while sealing to procure food. Twelve of the bodies of the dead were rescued and are now board the Thetis and Bear. One, the Esquimo Turnevick; was buried at Disco in accordance with the desire of the inspector of Western Greenland. Five bodies buried in the ice near the camp were swept away to sea by the winds and currents before my arrival and could not be recovered. The names of the dead recovered, with date of death, are as follows: Sergeant Cross, January 1, 1884; Wederick, the Esquimo, April 5; Sergeant Linn, April 6; Lieutenant Lockwood, April 9; Sergeant Rice, April 9; Corporal Salem, June 3; Private Bender, June 6; Assistant Surgeon Pavy, June 6; Sergeant Gardner, June 12. Drowned by breaking through the ice while sealing, Jens Edwards, an Esquimo, April 24.

I would urgently suggest that the bodies now on board be placed in metallic cases here for safer and better transportaion in a sea-way. This appears to me imperative. Greely abandoned Fort Conger August 9, 1883, and reached the Baird inlet September 29, following, with the entire party well. He abandoned all his boats and was adrift thirty days on the ice-floe in Smith's Sound. His permanent camp was established October 21, 1883, at the point where he was found. During nine months his party had to live upon a scant allowance of food brought

from Fort Conger that was cached at Prayer Harbor and Cape Isabella by Sir George Nares in 1875, but was found much damaged by the lapse of time; also on that cached by Beebe at Cape Sabine in 1882, a small amount saved from the wreck of the Proteus in 1883 and landed by Lieuts. Garlington and Colwell on the beach near where Greely's party was found. When these provisions were consumed the party was forced to live on boiled sealskin stripped from their sealskin clothing and lichens and shrimps caught in good weather when they were strong enough to make the exertion. As it took 1,300 shrimps to fill a gallon measure the labor was too exhausting to depend upon them to sustain life entirely. The channel between Cape Sabine and Littleton Island did not close, on account of violent gales, all winter, so that 240 rations at that point could not be reached.

All of Greely's records and all of the instruments brought by him from Fort Conger were recovered and are on board. From Hare Island to Smith's Sound I had a constant and furious struggle with the ice in impassable places. The solid barriers were overcome by watchfulness and patience. No oportunity to advance a mile escaped me, and for several hundred miles the ships were forced to run their way from lead to lead through ice varying in thickness from three to six feet, and when rafted much greater. The Thetis and Bear reached Cape York June 18, after a passage of twenty-one days in Melville Bay, with two advance ships of the Dundee whaling fleet, and continued to Cape Sabine, returning seven days later. We fell in with seven others of this fleet off Wostenholme Island and announced Greely's rescue to them, that they might not be delayed from their fishing grounds nor be tempted into the dangers of Smith's Sound in view of the reward of $25,000 offered by Congress. Returning across Melville Bay we fell in with the Alert and Lock Garry off Devil's Thumb struggling through heavy ice. Commander Coffin did admirably to get along so far with the transport so early in the season before the opening had occurred.

Lieutenant Emery with the Bear has supported me throughout with great skillfulness and unflinching readiness in accomplishing the great duty of relieving Greely. The Greely party are very much improved since their rescue, but were critical in the extreme when found and for several days after. Forty-eight hours delay in reaching them would have been fatal to all now living. The season in the north is late and the coldest for years. Smith's Sound was not open when I left Cape Sabine. The winter about Melville Bay was the most severe for twenty years. This great result is entirely due to the unwearied energy of yourself and the Secretary of war in fitting out this expedition for the work it has had the honor to accomplish.

[Signed] W. S. SCHLEY, Commander.

General Hazen, Chief Signal Officer, received the following telegram:

ST. JOHNS, N. F., July 17th.—For the first time in three centuries England yields the honor of penetrating farthest north. Lieutenant Lockwood and Sergeant Brainard, May 13, reached Lockwood Island, latitude 83° 24″, longi-

tude 44° 5″. They saw from 2,000 feet elevation no land to the northwest, but to the northeast Greenland yet extended, lost to view in Cape Robert Lincoln, latitude 83° 35″, longitute 38°. Lieut. Lockwood was turned back in 1883 by open water on the North Greenland shore, the party barely escaping drifting into the polar ocean. Dr. Parry, in 1882, following the Markham route, was adrift one day in the polar ocean north of Cape Joseph Henry and escaped to land, abandoning nearly everything. In 1882 I made a spring, and later a summer trip into the interior of Grinnell Land, discovering Lake Hazen, some sixty by ten miles in extent, which is fed by ice. The Cape of North Grinnell Land drains Ruggles River and Weyprecht fiord into Conybear's Bay and Archer fiord.

From the summit of Mount Arthur, 5,000 feet, the contour of the land west of Conger Mountain convinced me that Grinnell Land tends directly south from Lieut. Aldrich's farthest trip in 1876. In 1883 Lieut. Lockwood and Sergeant Brainard succeeded in crossing Grinnell Land, and ninety miles from Beautux Bay, the head of Archer's fiord, struck the head of a fiord from the Western Sea, temporarily named by Lockwood, Greely fiord. From the center of the fiord, in latitude 80° 30′, longitude 78° 30′, Lieut. Lockwood saw the northern shore termination some twenty miles west, the southern shore extending some fifty miles with Cape Lockwood some seventy distant, apparently separate land from Grinnell Land. He named the new land Arthur Land. Lieut. Lockwood followed, going and returning, an ice cape averaging about 150 feet perpeendicular face. It follows that Grinnell Land in the interior is ice-capped with a belt of country some sixty miles wide between the northern and southern ice capes. In March, 1884, Sergeant Long, while hunting, looked from the northwest side of Mount Carey to Hayes' Sound, seeing on the northern coast three capes westward of the farthest seen by Nares in 1876. The sound extends some twenty miles farther west than shown by the English chart, but is possibly shut in by land which showed up across the western end. The two years station duties, observations, all explorations and the retreat to Cape Sabine were accomplished without loss of life, disease, serious accident or even severe frost bites. No scurvy was experienced at Conger and but one death from it occurred last winter.

[Signed] GREELY, Commanding.

A second dispatch from Lieutenant Greely was as follows:

ST. JOHNS, July 17th.

CHIEF SIGNAL OFFICER, Washington:

Brainard, Biederback, Connell, Fredericks, Long and myself, sole survivors, arrived to-day, having been rescued at the point of death from starvation by the relief ships, Thetis and Bear, June 22, at Camp Clay, northwest of Cape Sabine. All are now in good health, but weak. Sergeant Ellison was rescued, but died July 6. Cross died last January; Christiansen, Linn, Rice, Lockwood, Jewell and Edwards in April; Ellis, Ralston, Whistler, and Israel in May; Kislingbury Salor, Henry, Bender, Pavy, Gardner and Schneider in June. We abandoned Fort Conger August 9, were frozen in a pack off Victoria Head August 29,

abandoned the steam launch September 11, eleven miles northeast of Cocked Hat Island. When on the point of landing we were three times driven by southwest storms into Kane's Sea. We finally landed September 29 in David Inlet. Learning by scouting parties of the Proteus disaster and that no provisions had been left for us from Cape Isabella to Sabine, we moved and established winter quarters at Camp Clay, half way between Sabine and Cocked Hat. An inventory showed that daily rations of four and one-third ounces of meat, seven ounces of bread and dog biscuits, and four ounces of miscellaneous food, the party would have ten days full rations left for crossing Smith's Sound to Littleton Island. Unfortunately Smith Sound remained open the entire winter, and crossing was impracticable. Game failed despite daily hunting from early in February. Before the sun returned only 500 pounds of meat was obtained this year. Minute shrimps, sea weed, sassafras, rock lichens, and sealskin were resorted to for food, with results as shown by the number of survivors. The last regular food was issued May 14. Only 150 pounds of meat was left by Garlington, which compelled me to send on November 4 men to obtain 144 pounds of English meat at Isabella. During the trip Ellison froze both hands and feet and lost them all; surviving, however, through our terrible winter and spring, until July 6. The survivors owe their lives to the indomitable energy of Captain Schley and Lieut. Emery, who, preceded by three, and accompanied by five, whalers, forced their vessels from Upernavik, through Melville Bay into Northwater, at Cape York, with the foremost whaler. They gained a yard whenever possible, and always held it. Smith's Sound was crossed and the party rescued during one of the most violent gales that we have ever known. The boats were handled only at the risk of swamping. Four of us were then unable to walk, and could not have survived exceeding twenty-four hours. Every care and attention was given us. We saved and bring back copies of meteorological, tidal, astronomical, magnetic, pendulum and other observations, also pendulum and standard thermometers, forty-eight photographic negatives. A collection of blanks and photographic proofs, Esquimo relics and other things were necessarily abandoned. The Thetis remains here five days probably.

[Signed] GREELY, Commanding.

The following despatch was sent Lieutenant Greely in reply:

SIGNAL SERVICE OFFICE, July 17.

LIEUTENANT A. W. GREELY, St. John:

Our hearts are flowing with gladness and thanks to God for your safety, and in sadness for those who without fault of yours are dead. Your family are well and at San Diego.

W. B. HAZEN.

The news of the rescue of Lieutenant Greely created much excitement in Washington City. The telegram from Commander Schley was received by Rear Admiral Nichols, acting Secretary of the Navy, who immediately communicated its contents to Lieutenant-General Sheridan, acting Secretary of War. They pro-

ceeded to the White House and showed the telegram to the President, who has taken deep interest in the expedition and who expressed great concern at the sad death of so many of the party. A copy of the telegram was telegraphed to Secretary Chandler at West Point, and to Secretary Lincoln at New York. The families of Lieut. Greely, Lieut.-Commander Schley and Lieut-Emery were also informed of their rescue. Rear Admiral Nichols to-day telegraphed Commander Schley at St. Johns, as follows: "Use your discretion about the care and transportation of bodies. Report by wire when ready to sail for New York. The department sends most hearty congratulations to yourself, officers and men."

The following despatch was forwarded by Secretary Chandler from West Point:

COMMANDER W. S. SCHLEY, St. Johns, N. F.:

Receive my congratulations and thanks for yourself and your whole command for your prudence, perseverance and courage in reaching our dead and dying countrymen. The hearts of the American people go out with great affection to Lieut. Greely and the few survivors of his deadly peril. Care for them unremittingly, and bid them be cheerful and hopeful on account of what life has yet in store for them. Preserve tenderly the remains of the heroic dead, prepare them according to your judgment, and bring them home.

[Signed] W. E. CHANDLER, Secretary of the Navy,

The following telegram was also sent:

LIEUTENANT GREELY, St. Johns:

Your dispatches are most satisfactory and show your expedition to have been in the highest degree successful in every particular. This fact is not affected by the disaster later.

W. B. HAZEN.

On arrival at the anchorage of the relief squadron an associated press correspondent interviewed Lieut. Greely and other survivors of the Arctic colony. The followidg facts were disclosed: After passing two winters at Fort Conger in scientific researches, Lieut. Greely, with his whole party intact, broke up their encampment and commenced a southward descent. This was accomplished amid great perils from gales of wind, ice nips and other casualties. Cape Sabine having been reached, a temporary home was erected, built of stone and covered by the boats' sails brought along by the party. On the 29th of September winter quarters were established at Cape Sabine. The commissariat had become very meager, and the cache of provisions left by the Proteus last year but poorly supplemented it. The steam launch had become fast on the ice a few weeks previous and had to be abandoned during the whole winter.

The first havoc in the ranks was early in January, when one of the men dropped off with scurvy. On the 9th of April Lieut. Lockwood and Mr. Rice, the photographer, succumbed after a heroic attempt to secure for their starving comrades about 200 pounds of meat supposed to be cached at a place named Bad Creek, distant about fifteen miles from the encampment. Israel, the astro-

nomer, perished May 27th; L. Kislingbury died June 1st, and Dr. Pavy, the naturalist, slept in death June 6th. Not one of the victims realized that death was so near. They all died a tranquil, painless death. Two Esquimaux also perished; one of starvation, the other drowned, his kayak being pierced by some newly formed ice April 17th, thus cutting off all prospecting for a supply of seal meat for the starving explorers. The Esquimaux were most faithful and devoted followers and helpers of Lieut. Greely. Ellison was rescued and safely brought on board the steamship Bear, where he died a few days subsequently. His is an extraordinary instance of human endurance. While away some ten miles from his hut last winter the temperature suddenly dropped 48° below zero. His hands and feet were frozen to the very bone, and he was dragged by his comrades in an almost dying condition to his hut. His feet and hands were literally amputated by the incisive frost, and in this terrible state he lived through the dismal months that intervened between that time and the rescue.

The bodies of twelve of the victims have been brought up by the steamers Bear and Thetis, embalmed in tanks filled with alcohol. The survivors are all doing well and rapidly gaining flesh and strength. Lieut. Greely, who was in an exceedingly critical condition when transferred to the Thetis, is now able to move about. This morning he drove out for an hour's ride to get the country air and came back quite recuperated.

The rescue took place on the 22d of June under circumstances of great difficulty. The Thetis and Bear lay off from the shore about three hundred yards. There was a terrific gale blowing from the southwest, a heavy sea was running, and a formidable ice nip was apparently inevitable. Lieut. Greely and the other six survivors had to be transferred from their camp to the steam launch and whale boat in their sleeping bags, and while steaming from land to the ships the destruction of the whole party at one time seemed certain. The sea swept furiously over them, and the fury of the wind threatened at every instant to capsize them.

At length they were safely placed on board the rescuing squadron, where every possible preparation had been made to secure their recovery. The Greely party reached the highest latitude ever yet reached by polar explorers, namely, 83° 25 5-10′. The coast of Greenland was carried up to 85° 35′, by observation, and named Cape Lincoln. The steamship Alert parted company with the squadron yesterday off Turk Island and has not yet reached port.

It was discovered during the past winter by Lieut. Greely that Cape Sabine was part of an island, not the mainland, as was thought by previous geographers. It is separated from the mainland by a narrow creek, now called Rice's Strait, in memory of the dead photographer. Lieut. Greely informed a correspondent that a large body of valuable scientific work had been done during the two seasons spent at Fort Conger by himself and his lieutenants. About 2,500 miles of exploration had been effected and many valuable observations, magnetic, thermometeric and meteorologic had been made. The winter of 1881 was the severest of the three. The mean of the thermometer during February was 48° below

zero. Seals were observed as high up in latitude as 81° and 8°. Several varieties of ducks were observed and a variety of other birds known and unknown to ornithologists. Over 100 musk-oxen were slaughtered during the two weeks' residence at Fort Conger. Their flesh proved very valuable food, being palatable, wholesome and nutritious. The whole official work of the expedition, plans, sketches and photographic plates and scientific sketches, have been saved and brought home by Lieut. Greely.

Sergeant Long, of the Greely party, who was the first to respond to the welcome tone of the steam whistle, says he and Sergeant Brainard were first to hear the sound and they helped each other to crawl out of the tent. When Long got clear of the entanglement of the tent, which had been swept to the ground, he rose to his feet with great difficulty and succeeded in clambering up to the rock that gave the most extensive view in that neighborhood, and Brainard went back to the tent, but Long remained looking out searchingly in every direction for some strange object. At length he saw the unwonted sight of a large black object about a mile distant, which at first looked like a rock, but he knew there was no rock in that line. Suddenly the approaching steam launch changed its course and Long recognized the approach of the rescuers.

He came down from the rock, went toward the camp, raised the flag pole and flag which had been blown down during the gale and held it for about two minutes—until his strength gave out and it was blown once more to the ground. He then advanced totteringly in the direction of the little steamer and in a few minutes the warm hand of Captain Ash had grasped his in greeting.

Maurice Connell, who is still excessively weak, stated in an interview that for some days after his rescue he had no recollection of anything that transpired. He did not hear the awakening scream of the whistle and when his comrades shook him up from his prostrate position in camp and told him succor was at hand, he wildly exclaimed "for God's sake let me die in peace!" A teaspoonful of brandy applied to his lips called back the fleeting life-spark, for Connell could not have survived more than a few hours. He was by far the weakest of the seven survivors, and the strongest must have succumbed within forty-eight hours.

The story told by Connell from his recollection of their starving experience is simply heartrending. How they burned the hair off their sealskin boots and coats, cut them into strips, boiled them into stew and ate voraciously of them till their stomachs rebelled and nausea and weakness ensued. In several cases nature gave no call for twelve, fifteen and even eighteen days, and then bloody hemorrhage and consequent weakness ensued, prostrating the victim for several days. The difficulty of keeping the heat in the body was very great. The rule of the camp was to permit no one to sleep longer than two hours. He was awakened roughly and called upon to shake himself, beat his hands and pound his feet and restore circulation. This was found absolutely necessary to prevent torpor and possibly death, the usual accompaniments of intense cold.

Commander Schley has received instructions from the Secretary of the Navy

to remain at St. Johns until there are twelve iron caskets constructed to receive the bodies of the deceased explorers. The survivors are all doing well, but are still weak and suffering from nervous prostration. Lieut. Greely has improved from 120 pounds, his weight on the 22d of June, to 169 pounds. Sergeant Brainard and others are pulling up proportionately. The weather here is delightful, and all that could be desired for the sufferers, the mercury ranging between 65° and 75°. Great sympathy is evinced by all classes here, alike for the survivors and the dead, and every token of respect is manifested for them.

The Thetis and Bear as they ride quietly at anchor in the harbor of St. Johns wear a somber and mounful appearance, with the flag of the United States at half mast. The United States war ship Alert arrived here at 8 P. M. Her detention was caused by fog and search for the other ships of the squadron. All on board are well.

Sergeant Julius R. Fredericks relates a mournfully tragic story of the sad death on the ice covered ground of George Rice, the artist of the expedition. April 6th Rice and Fredericks volunteered to leave camp to proceed a distance of twenty-five miles for some meat that was cached near Cape Isabella. They had a sled, rifle and hatchet and provisions for five days. They traveled for three days, but failed to find the cache. On their way to camp, Rice became weak and finally gave up. He was attacked by bloody flux that gradually wore him down. He succumbed and was interred in an ice grave by his companion. Fredericks camped out that night under the fragment of a boat and next day revisited his companion to pay his last tribute to his remains. Fredericks retained sufficient strength to drag back the sled with the hatchet, rifle and cooking utensils to the camp, where he encountered more woe in the form of the death of Lieutenant Lockwood, another of the party. The cached meat that Fredericks and Rice were in search of was brought by them April 6th, from Cape Isabella and abandoned next day in order to drag Ellison, one of their party who had been frozen, into camp. Rice was the life of the Greely party, full of hope, buoyancy and energy, and his death was a terrible blow to them. He died in a brave struggle to prolong their existence.

Meager as the news is of the details of the rescue, the fearful mortality of the little colony in its endeavors to escape from exile, tells a story of hardships and suffering that needs no elaboration.

The party was rescued at Cape Sabine in latitude 79° and opposite Littleton Island, near where the Proteus sank last year, en route to rescue the Greely colony at Lady Franklin's Bay, in latitude 82°. The long journey over a trackless waste of snow and ice, with great glaciers to traverse, between Lady Franklin's Bay and Cape Sabine, must have been full of toil and suffering, with many examples of heroic fortitude and endurance, for it is understood the whole party reached Cape Sabine in safety.

There the great sufferings began, for the borean blast of the polar region kept the sea open, and being without boats Littleton Island could not be reached, where provisions were cached the year previous by the ill-fated Proteus expedition.

Starvation sat in, and famine, combined with exposure, took one after the other off, until seven only of the twenty-five picked men for this polar expedition were left to tell the story of the last Arctic tragedy.

Besides Lieut. Greely there were two other commissioned officers and a surgeon, and of these Lieut. Greely alone survives, the other survivors being enlisted men.

It is strange, or appears so to the writer, that Lieut. Greely, whom he knew well, should have been one of the survivors. He was not a strong man, or robust in appearance. He is about six feet tall, slender, rather delicate in appearance, and very nearsighted. He is the last man any of his acquaintances would have thought would volunteer for such perilous service, and having volunteered, it was believed he never would survive the hardships.

First Lieutenant Greely, of the Fifth Cavalry, became fired with zeal and enthusiasm about the meteorology of the polar regions through his connection with the Signal Bureau of the army, and he was led even before he started on this expedition to volunteer to go out in the Gulnare, a vessel Captain Howgate, of the Signal Service, had fitted out for polar exploration, but which was condemned as unseaworthy before she set sail. Lieut. Greely's survival is fortunate, aside from the gratification we must all feel because of the rescue of so gallant an officer, because if the two years' residence in the Arctic regions has developed anything beneficial to science, Lieut. Greely will be most competent to impart it.

The loss of the others will be deeply deplored, while all must rejoice over the salvation of the few.

One of the most prominent, and decidedly the most enthusiastic member of the Greely party, was Dr. Octave Pavy, a citizen of Missouri, who died of starvation on June 6th of this year. The Doctor was born in France, June 22, 1845, and did not come to America until just before the close of the Franco-Prussian war. He was a gentleman of high attainments, a ripe scholar, skillful surgeon, facile writer and genial companion. He was almost a monomaniac on the subject of polar explorations and for several years acted as Private Secretary for Lambert, the renowned French scientist and explorer, also an enthusiast on Arctic discoveries. He imbued the young Frenchman with the same spirit for research in the regions of the frozen North. Lambert had received assurances from the French Government that an expedition would be fitted out to go to the Arctic circle, of which he was to receive command, and Pavy would have been one of his associates, but the Franco-Prussian war put an end to the proposed expedition.

In 1878 Dr. Pavy married Miss Lilla Stone, the daughter of a minister at Lebanon, Ill., an estimable and talented lady who encouraged her husband in his cherished designs. For two years and a half Mr. and Mrs. Pavy resided in St. Louis, and he was employed for some time as physician in the Meyer Iron Works. The unfortunate Frenchman talked constantly about a trip to the pole, and it was through Lieut. J. H. Weber, of the United States Signal Service in St. Louis, that he was brought into communication with Captain Howgate, which

resulted in his engagement as surgeon and naturalist on the Gulnare, and his subsequent addition to the ill-fated Greely party. The widow of Dr. Pavy is residing at Maryville, Mo., where she has been conducting a select school for young ladies. The deceased had a number of friends in St. Louis, who regret that he came to such a terrible death. A movement was started on 'Change, in St. Louis, by D. R. Francis, Michael McEnnis, Ewing Hill, Seth Cobb and other prominent merchants, to raise a fund for the support of the heroic wife of Dr. Pavy, who has been left in embarrassed circumstances. It is urged in behalf of the subscription that Dr. Pavy was the only member of the Greely expedition who resided in Missouri, and it would be a graceful compliment to the worthy widow and a mark of respect to the dead, were a liberal sum presented to her with the best wishes of the people of St. Louis and Missouri.

Until Lieut. Greely's reports are made public this polar expedition cannot be declared a failure, but the disposition is to entertain the belief that nothing can be learned behind the ice barriers of the north that will compensate for the sufferings every polar expedition has entailed and the loss of life all have caused.

The "open polar sea" is as much of a mystery as ever. A great majority of navigators and men of science are convinced that the northern hub of the universe is surrounded by solid ice, and yet one of Lieut. Greely's dispatches intimate that there really is open water up in that region, as the minority claim. In a year or two, we suppose, after Greely's discoveries have been published and suggested, somebody will propose fitting out another expedition to solve the problem. The scientific results, if any, accomplished by the colony at Lady Franklin Bay are yet to be made known.

As barren and destitute of the means of sustenance as Lieut. Greely found the polar region, there is a well defined theory among scientists that life began at the poles. The theory is that the poles were at first fitted to produce life, which consequently began at the northern and southern extremities of the globe, developing independently, but to a certain extent correspondingly, as the conditions were similar. By the secular cooling of the earth the poles finally became unfitted to support life, and such forms as did not perish in the changes of the earth's surface slowly migrated toward the equator, changing in the course of years, and ultimately giving rise to a fauna which over the most of the globe consists of a mixture of northern and southern forms.

Many facts derived from the Northern Hemisphere lend support to this theory, and the Southern Hemisphere is adding facts to confirm the theory. The animals of the Northern Hemisphere are almost identical throughout the world's circuit. The same families and even the same species of mammals and birds are common to the North in the Old and New World. The elk, reindeer, the beaver, lynx, fox, and wolf, for instance, of the Old World are specifically identified with those of the New.

Remains of animals now regarded as tropical, such as the elephant, hippopotamus, lion, etc., are common in the tertiary strata of temperate and even the polar regions. This is proof of a southern migration when the climate changed.

In Patagonia remains of mammals are found which tend to show that the fauna of Patagonia preceded that of the Argentine Republic, and, moreover, the animals of South America have their counterpart in Australia and Africa. The flora of the Southern Hemisphere in the Old and New Worlds correspond, and the fossil remains in the Eastern and Western Hemispheres correspond around the world's circuit. These resemblances become more marked when fishes, insects, and the mollusca of the Old and New Worlds are considered.

At least one result gratifying to our national vanity has been accomplished by the polar expeditions from the United States within the last fifteen years—the geography of the Arctic regions has been enriched by a great many familiar American names. The English for a long time had a monopoly of this nomenclature, and the names of their great explorers, naval commanders, reigning princes, and some of their "sisters, cousins, and aunts," are perpetuated in the gulfs, straits, channels, capes, headlands, and islands of the polar seas. The expedition of Captain Hall, and the two years' residence of Lieut. Greely in the upper polar regions, has given to some of the prominent men of our own country a place in Arctic geography.

Cape Robert Lincoln at present overtops all the designated points on the polar map. It is in north latitude 83° 35′, longitude 38°. It may be a century before the explorers of any other land carry a historic name nearer to the pole. Lockwood Island, named in honor of the gallant young soldier who discovered it, is in latitude 83° 24′, and this may for many years remain one of the extreme outposts of Arctic discovery. Arthur Land is not quite so far away, but still it is some thousands of miles too near the Pole to be an agreeable place of residence. We have Hayes Sound, Greely Fiord, Cape Joseph Henry, Hazen Lake, and many other titles that bring before us the men of our own generation, whose names have been used to designate land-marks and water marks on the way to the Pole.

The admirable dispatches from St. John's give a most interesting account of the operations of Lieut. Greely's party during their two years' stay at Fort Conger, and of the mode of living at a hyperborean station. Astronomical, meteorological, and magnetic observations were taken every day until the station was abandoned. A number of the dogs taken to the station died during the first season, but by taking good care of those that were left, and of the new litters that from time to time appeared, Lieut. Greely was able to keep up effective teams for exploration. A number of expeditions were made across the channel to the Greenland Coast. The lowest natural temperature ever recorded was noted by Sergeant Brainard during one of these expeditions—minus 61°. Two of the men, Rice and Jans, returned to the station to get some additional supplies for one of the exploring parties, travelling a distance of fifty miles, without sleeping bags or tents, the temperature being minus 40°. They got what was needed and went back to their party, making the trip in five days. If Arctic exploration does nothing else, it shows that the human body can endure a great deal of cold.

When Lieut. Lockwood made his journey to the highest northern point ever

trodden by man (83° 24.5′) he was accompanied by only two men—Brainard and Christiansen. He carried thirty-five days' provisions on a sled drawn by dogs. At this remote point traces of rnimal life were abundant, tracks of hares, lemmings, ptarmigan, and snow-bunting; a little further south were seen the tracks of bears and signs of the musk-ox. This expedition lasted fifty-nine days, and no one engaged in it suffered any serious consequences from the prolonged exposure.

NEW ZEALAND.

W. DAWSON, SPICELAND, IND.

Having been much interested in Professor Pritchett's article on "The Transit of Venus in New Zealand," in the February number of the REVIEW, I have thought some account of the geography, etc., of that colony might, perhaps, be of interest as a kind of supplement to the professor's article.

New Zealand is an English colony of two large islands and a much smaller one, with a number of islets, in the south Pacific Ocean; and pretty nearly on the opposite side of the earth. They are about 1,200 miles southeast of Australia, and 7,000 miles nearly southwest of San Francisco. Although far away, it is a fine and interesting country.

Imagine a long and narrow island lying in a direction nearly northeast and southwest, divided near the middle by Cook's Strait. North island, often called New Ulster, is very irregular in shape; the northwestern part extending far into the ocean, narrows to a point. The northeastern part extends out about one-fourth as far, and rounds off much more obtusely. So the shape of this island is somewhat like a shoe. South island—New Munster—is pretty nearly a parallelogram in shape, and the two taken together resemble a boot in outline as well as Italy does.

Their extreme length is nearly a thousand miles, and the average width about 100 miles. New Ulster is about the size of New York, containing about 48,000 square miles. South island is somewhat larger. The third, called Stewart's Island, is south of New Munster, and Foveaux Strait, fifteen miles wide, is between them. This island is triangular in shape, and contains nearly 1,000 square miles. Cook's Strait is in latitude 40° S.; and longitude 185° W. of Greenwich. It took its name from James Cook, the renowned navigator, who surveyed New Zealand about 1770.

These islands are considerably mountainous; several peaks having an elevation of about two miles. Mt. Cook, in South island, is 13,000 feet high. Many extinct and a few active volcanoes exist. Earthquakes occur sometimes. The coasts are indented with numerous bays, many of which afford excellent harbors. "The climate of New Zealand is one of the finest in the world." The atmosphere is damp, though pure and healthy; disease and sickness being compara-

tively rare. In South island the mean annual temperature is about 52°; in New Ulster 58°. Beautiful plains of country are always clothed in green foliage, and afford rich pasture for great herds of cattle, and vast numbers of sheep, which are thus grown with very little expense. The soil is very productive and easily worked, making agriculture a light and easy employment. A large plant, having leaves two inches broad and six feet long, called New Zealand flax, is a production of great value for home use and export. The leaves contain a very strong fibre used for making rope, twine, linen, etc.

The coast and rivers of New Zealand abound in vast quantities of fish. Captain Cook, in one of his visits there, thought to show the people how to catch fish by exhibiting a seine; but they smiled and pulled down a stack of netting from which they spread a seine four times as large as his. Coal exists there in great abundance. Gold was discovered in New Munster in 1861. The deposit was found to be very rich, and in a few years the product amounted to many millions of dollars. This country was discovered in 1642 by Abel Tasman. For many years after, it was known only as a stopping place for whalers. The natives were cannibals, but were very susceptible to the influences of civilization and religion. A few English had settled there; and in 1814 a missionary station was established on the Bay of Islands, near the north end of New Ulster. About ninety miles south of this the city of Auckland is located; which is still in the northern part of North island. It will be remembered that Auckland is the "well governed city" where Professor Pritchett made his observations. The missionary station on the Bay of Islands was very successful, and Christianity spread over the island to a large extent. But in twenty or thirty years, more emigrants came who were greedy for the fine country. They oppressed the people—provoking them to retaliation, and causing much cruelty; so that Christianity was greatly impaired.

In 1840, the sovereignty of New Zealand was ceded to the British Government. But in a few years new and bloody conflicts arose, because foreigners took possession of lands which the natives believed they had no right to. Finally, some years later all became reconciled, and everybody went to work in good earnest—tilling the soil and advancing the cause of humanity in general. In 1851 the population of New Zealand was estimated at about 146,000—26,000 being foreigners. But since then the natives have decreased about two-thirds, and foreigners increased to about 500,000. As in other countries so in that one—the opening of gold mines was a great incentive to rapid immigration and various improvements. New Zealand has one university of learning, several colleges, and a general free school system of education.

The lamented Captain Cook has given much interesting information about New Zealand, as well as many other islands in the Pacific Ocean.

A NEW VOLCANO.

The Secretary of the Treasury has received from Captain M. A. Healy, of the United States revenue cutter Corwin, under date of Ounalaska, May 28th, two interesting reports by officers of the Corwin describing a visit to the recently upheaved volcano in Behring Sea at the northern end of Bogosloff Island, in latitude 53° 55′ 18″ N.; longitude 168° 00′ 21″ W.

This volcano, which is in a state of constant and intense activity, was upheaved from the sea in the summer of 1882, but was not seen by any civilized eye until September 27, 1883, when it was discovered by Captain Anderson, of the schooner Matthew Turner. A few days later it was also seen by Captain Hague, of the steamer Dora, but no landing upon it was made previous to that by the officers of the Corwin last spring.

Dr. Yemans describes it as a dull gray, irregular, cone-shaped hill, about 500 feet in height, from the sides and summit of which great volumes of vapor were arising. At a height of about two-thirds the distance from the base to the apex of the cone, there issued a very regular series of large steam jets, which extended in a horizontal direction completely across the northwestern face of the hill. Around these steam jets were seen upon nearer approach deposits of sulphur of various hues, which at a distance had looked like patches of vegetation. A landing was effected without difficulty upon a narrow sand spit connecting the new volcano with the old island of Bogosloff, and Dr. Yemans and Lieut. Cantwell undertook the ascent of the smoking cone. It was covered by a layer of ashes formed into a crust by the action of rain, which was not strong enough to sustain a man's weight, and at every step the climbers' feet crushed through it, and they sank knee-deep into a soft, almost impalpable dust which arose in clouds and nearly suffocated them.

As the summit was neared the heat of the ashes became almost unbearable. A thermometer buried in them half way up the ascent marked 196°, and in a crevice of the ramparts of the crater "the mercury rapidly expanded and filled the tube, when the bulb burst, and shortly afterward the solder used in attaching the suspension ring to the instrument was fused." The temperature was estimated at 500° F. On all sides of the cone were perforations through which the steam escaped with more or less energy, and in some cases at regular intervals like the exhaust of a steam engine. The interior of the crater could not be seen on account of the clouds of smoke and vapor which filled it.

"A curious fact to be noted," Lieut Cantwell says, "in regard to this volcano is the entire absence, apparently, of lava and cinder, Nowhere could I find the slightest evidence of either of these characteristics of other volcanos hitherto examined in the Aleutian Islands." Volcanic dust or ash, however, is thrown out in considerable quantities and carried by the wind to places as distant as Ounalaska. After carefully measuring the volcano and photographing it from various points of view the exploring party returned without accident to the ship. Captain Healy reports his intention to visit the new volcano again on his return from St. Michaels and the Arctic.

MEDICINE AND HYGIENE.

THE RELATIONS OF THE SOIL TO HEALTH.[1]

GEORGE H. ROHE, M. D.

I. THE SOIL.—That wisest and most learned of the ancients, Hippocrates, called the Father of Medicine, treated at length in one of his works of the sanitary influence of the soil. Other of the older writers, especially Herodotus and Galen, called attention to the same subject, and Vitruvius, the celebrated Roman architect, who flourished about the beginning of the Christian era, taught that a point of first importance in building a dwelling was to select a site upon a healthy soil.

From this time until the beginning of the eighteenth century, very little of value is found in medical literature bearing upon this subject. In 1717, however, Lancisi published his great work on the causes of malarial fevers, in which he laid the foundation for the modern theory of malaria and pointed out the relations existing between marshes and low-lying lands and those diseases, by common consent, called malarial. Other authors of the eighteenth and the early part of the nineteenth century refer to the connection between the soil and disease, but exact investigations have only been made within the last thirty years. The general want of definite knowledge upon this subject, even among well-educated people, is the occasion of the following pages.

When we consider that the air we breathe, and much of the water we drink, are influenced in their composition by the matters in the soil, the great importance of possessing a thorough knowledge of the physical and chemical conditions of the soil becomes evident to every one.

In the hygienic, as in the geological sense, we include rock, sand, and gravel in the consideration of soils.

The soil, as it is presented to us at the surface of the earth, is the result of long ages of disintegration of the primitive rocks by the action of the elements, of the decomposition of organic remains, and possibly of accretions of cosmical dust. The principal factor, however, is the action of water upon rock, in leveling the projections of the earth's surface, produced by volcanic action.

Soils vary considerably in physical and chemical constitution. We may have, for example, a soil consisting exclusively of sand, of clay, or of disintegrated calcareous matter. Other soils may consist of a mixture of two or more of these, together with vegetable matter undergoing slow oxidation. In forests, we find a layer of this slowly decomposing vegetable matter of varying thickness covering the earthy substratum. This organic layer is called *humus*, and when

1. From the Third Annual Report of the State Board of Health of West Virginia.

turned under by plow or spade, and mixed with the sand or clay-base, it constitutes the ordinary agricultural soil.

II. THE ATMOSPHERE OF THE SOIL, OR GROUND AIR.—The interstices of the soil are occupied by air or water, or by both together. The soil's atmosphere is continuous with and resembles in physical and chemical properties that which envelops the earth. Its proportion to the mass of the soil depends upon the degree of porosity of the soil and upon the amount of moisture present. In a very porous soil, such as for example a coarse sand, gravelly loam, or coarse-grained sandstone, the amount of air is much greater than in a clayey soil, granite, or marble. So, likewise, when the soil contains a large proportion of water, the air is to this extent excluded. The porosity of various soils, as evidenced by the amount of air contained in them, is much greater than would at first thought, be supposed. Thus it has been found that porous sandstone may contain as much as one-third of its bulk of air, while the proportion of air contained in sand, or loose soil may amount to from thirty to fifty per cent.

The ground-air is simply the atmospheric air which had penetrated into the interstices of the soil and taken part in the various chemical decompositions going on there. In consequence of these chemical changes, the relative proportions of the oxygen and carbonic acid in the air are changed, oxygen disappearing and giving place to carbonic acid. It is well known that, during the decay of vegetable matter in the air, carbonic acid is formed; one constituent of this compound —the carbon—being derived from the vegetable matter, while the oxygen is taken from the air. Hence, if this action takes place where there is not a very free circulation of air, as in the soil, the air there present soon loses its normal proportion of oxygen, which enters into combination with the carbon of the vegetable matter to form carbonic acid.

Thirty years ago, MM. Boussingault and Levy, two distinguished French chemists, examined the air contained in ordinary agricultural soil, and found that the oxygen was diminished to about one-half of the proportion nominally present in atmospheric air, while the carbonic acid was enormously increased. The exact results obtained by Boussingault and Levy were as follows:

In one hundred volumes of ground air there were 10·35 volumes of oxygen, 79·91 volumes of nitrogen, 9·74 volumes of carbonic acid. In atmospheric air, on the other hand, there are in one hundred volumes 20·9 volumes of oxygen, 79·1 volumes of nitrogen, 0·04 volumes of carbonic acid, or about one twenty-fifth of one per cent of carbonic acid.

In spite of the striking results obtained by these two chemists, very little attention was paid to them by sanitarians, as very few seemed to have any clear notion of the relations existing between the motions of the air above ground and that under ground.

In 1871, however, Prof. Von Pettenkofer, of Munich, whose authority in sanitary matters is second to none, published the results of his own examinations into the constitution and physical conditions of the ground air, and the relations of the latter to the propagation of epidemic diseases. These researches, which

created a widespread interest in the subject, were extended by other observers in all parts of the world. These observers, prominent among whom were Professors Fleck and Fodor in Germany, Drs. Lewis and Cunningham in India, Prof. Wm. Ripley Nichols in Boston, and Surgeons J. H. Kidder and S. H. Griffith, of the U. S. Navy, in Washington, demonstrated that the increase of carbonic acid in the ground air is due to increased vegetable decomposition and to lessened permeability of the soil. A permeable, that is to say, a sandy or gravelly soil, is likely to contain less carbonic acid in its atmosphere than a dense, less permeable clay, although the amount of decomposition going on, and the production of carbonic acid in the former, may considerably exceed the latter. In the loose sandy soil the circulation of the air is less obstructed, and the carbonic acid may easily escape and be diffused in the superincumbent air, while the close-pored clay imprisons the carbonic acid and prevents or retards its escape into the air above.

The disappearance of oxygen from the ground atmosphere is coincident with the production of an equivalent amount of carbonic acid. It appears from this that in the soil an oxidation of carbonaceous substance takes place, the product of which is the excess of carbonic acid in the ground air.

Prof. Nichols has found the proportion of carbonic acid in the air taken from a depth of ten feet below the surface in the "made land" of Boston, amount to 21·21 per thousand, the observation being made in August. In December, at a depth of six feet, the proportion was 3·23 per thousand. Fodor, in Buda-Pesth, found the proportion of carbonic acid to be 107·5 per thousand (over 10 per cent), the air being taken from a depth of thirteen feet.

Movements of the ground atmosphere are principally due to differences of pressure and temperature in the air above ground. Owing to such differences the air from the soil frequently permeates houses, entering from cellars or basements. In winter, when the air of houses is very much more heated (and consequently less dense) than the air out of doors, the difference of pressure, thus caused, draws the ground air up through the house, while the cold external atmosphere penetrates the soil and occupies the place of the displaced ground air.[2] A similar effect occurs in consequence of heavy rains. The water fills up interstices of the soil near the surface, and forces the ground air out at points where the pores remain open. These places are the dry ground under buildings, where the air escapes and passes through floor and ceilings into the house above. Heavy rains may thus be the cause of pollution of the air in houses. The greater the porosity of the soil, the more likely is this to happen. This pollution of the house air may be prevented by having impervious floors and walls to cellars and basements, or by interposing a layer or charcoal between the ground and the floor of the house.

In the spring and early summer the ground being colder than the air above

2 It is, of course, not strictly correct to say that the air *is drawn up* through the house by the diminution of pressure; it being rather *forced* out of the soil by the colder and denser outside air; but the phrase is sufficiently exact and will be readily understood.

it, and the ground air consequently heavier and denser, the latter is not easily displaced. It is perhaps due to this fact that those infectious diseases which are probably dependent upon the movements of the ground air, are less prevalent in the spring and early summer than in the latter part of summer, autumn, and early winter. In the autumn, the ground air being warmer than the air above ground is easily displaced by the latter, and forced out into the streets and houses to be inspired by men and animals. The same conditions may explain the greater likelihood of infection at night, which is proved for such diseases as malarial and yellow fevers. The colder outside air penetrates the interstices of the soil, and forces out the impure ground air.

The researches of Fodor have demonstrated that the proportion of carbonic acid in the ground air may be taken as an approximative measure of the impurity of the soil whence the air is taken. The influence of the permeability of the soil, as before pointed out, must however not be overlooked in estimating the signification of the carbonic acid. Fodor has shown that the proportion of carbonic acid in the ground air, and consequently the amount of organic decomposition, is greatest in July and least in March. That the carbonic acid is derived from the decomposition of organic matter has been proved by Pettenkofer. This observer examined specimens of air brought from the Libyan desert, and found that the proportion of carbonic acid in the ground air was exactly the same as in the air collected above ground. There being no vegetable growth in the desert there can, of course, be no vegetable decomposition going on in the soil.

The excess of carbonic acid in the ground air is an indication of the deficiency of oxygen, as has been shown. The air at a depth of thirteen feet below the surface was found to contain only from 7 to 10 per cent of oxygen—one-half to one-third of the normal proportion. Many basements occupied by people as living rooms extend from five to ten feet under ground, and hence are liable to be supplied with an atmosphere approaching in impurity that just mentioned. It requires no very vivid imagination to appreciate the dangers to health that dwell in such habitations.

III. THE WATER OF THE SOIL, OR GROUND WATER.—At a variable depth below the surface of the ground, a stratum of earth, or rock, is found, through which water passes with difficulty, if at all. Above this, there is a stratum of water which moves from a higher to a lower level, and which varies in depth at different times according to the amount of precipitation (rain or snow-fall) and according to the level of the nearest body of water toward which it flows. This stratum of water is termed the *ground water*, and has within the last few years assumed considerable importance from its apparently close relations to the spread of certain of the infectious diseases. The direction of horizontal flow of the ground water is always toward the drainage area of the district. Thus, it is usually toward lakes, rivers, or the sea. Rains or a rise in the river cause a rise in the ground water, while long continued dry weather, or a low stage of the river, which drains off the ground water, causes a fall in the latter. On the sea-coast the ground water oscillations probably correspond with the tides. The writer is not

aware of any observations made to determine this point. In Munich, where the ground water flows toward the river Isar, which divides the city, it has been found that the annual range or oscillation (the difference between the highest and lowest level during the year) is ten feet, while the horizontal movement amounts to fifteen feet per day. In Buda Pesth the annual range was found by Fodor to be less than three feet, while in some portions of India it amounts to more than forty feet. As it is from the ground water that the greater portion of the supply of drinking water in the country and in villages and small towns is drawn, it becomes at once manifest how important it is to prevent, as far as possible, pollution of this source. Cesspools and manure heaps and pits, of necessity, contaminate the soil, and also ground water, for a distance below and around them, and such water is clearly unfit for drinking and other domestic purposes. Hence, the reason why wells should not be placed too near privies and manure heaps or pits becomes apparent.

Between the level of the ground, or that portion of the soil where its pores are entirely occupied by the water—where, in other words, the ground is *saturated*—and the surface is a stratum of earth more or less *moist;* that is to say, the interstices of the soil are partly filled with water and partly with air. It is in this stratum that the processes of organic decay or putrefaction are going on, in consequence of which the pollution of the ground air occurs. Recent observations seem to show that these processes of decomposition are initiated and kept up by minute organisms, termed *bacteria,* just as fermentation in liquids containing sugar can only take place in the presence of the yeast plant. It has been found that when non-putrefactive decomposition goes on, there are always present multitudes of one variety of these minute organisms; while if putrefactive decomposition is going on, a different variety of these organisms is present. Just as, when a fermenting liquid becomes putrid, the yeast plant disappears and its place is taken by the ordinary bacteria of putrefaction, so in the soil, if the access of oxygen which is necessary to the life of the bacteria of decay is prevented, these organisms die and are succeeded by the organisms of putrefaction. It has been found that in a soil saturated with water the bacteria of decay cannot live, while those of putrefaction may flourish, because these latter organisms can sustain life in the absence of oxygen. Prof. Fodor's researches indicate that the organism of non-putrefactive decomposition or decay is that which is termed by Cohn *bacterium lineola;* and that the *bacterium termo* is the principal organism of putrefaction.

IV. The Diseases Spread by Soil Impurities.—Given now an area of soil, say the ground upon which a house or city is built, with a moist stratum in which the processes of decay are active, and imagine a rise in the ground water. The ground air, charged with carbonic acid and other products of decomposition, is forced out of the pores of the soil by the rising ground water, and escapes into the external air, or through cellars and basements into houses, and may there produce disease. But the saturation of the soil with water prevents the further development of the bacteria of decay, and putrefaction takes place. If, now, the ground water sinks to its former level or below, the processes of the decay again

become very active in the moist stratum, and large quantities of carbonic acid and other inorganic compounds are produced. If the germs of infectious or contagious diseases have been introduced into the soil, they also multiply, and may escape with the movements of the ground air into the external atmosphere, and there produce their infective action.

This, it is held by Pettenkofer and his followers, is what actually occurs in cholera and typhoid fever. Prof. De Chaumont has laid down the rule that a soil with a persistently low stage of ground water, say fifteen feet below the surface of the ground, is healthy; a persistently high stage of ground water, less than five feet below the surface, is unhealthy, while a fluctuating level of the ground water, especially if the changes are sudden and violent, is very unhealthy. This would lead us to expect that places where this fluctuation is very great would show a large mortality from such diseases as are attributed to impurities in the soil. And this we find especially true in India. In certain localities in India, cholera, for example, is endemic—that is to say, the disease is never entirely absent in such localities. Calcutta is one of these places. The rainy season begins about the first of May and continues until the end of October. During the next six months there is very little rain. It is fair to assume that the ground water rises during the rainy season, and checks decay and the multiplication of the germs of the disease in the soil, and that these processes become more active as the dry season advances and the ground water level falls. If we note the death-rate from cholera in Calcutta, it will be found that it bears a distinct relation to the movement of the ground water. The deaths from cholera begin to increase from October, and reach their height in April. Dr. Macpherson, who has written a very elaborate history of Asiatic cholera, shows this relation very clearly. For twenty-six years the average annual rainfall was sixty-three inches. From May to October fifty-seven inches fell, while the remaining six inches fell from November to April. The average number of deaths from cholera annually was 4,013. Of these, 1,238 died in the rainy season, while 2,775—nearly three-fourths—died during the period of dry weather.

In the cholera epidemics of 1866 and 1873 in Buda-Pesth, the same relations existed between the ground water and the cholera. As the level of the ground water rose, the cholera diminished, while the disease increased upon the sinking of the ground water. Exactly the same behavior was exhibited by the disease in Munich in 1873.

There seems good reason to believe that typhoid fever is propagated in consequence of movements of the ground water, in the same way as above explained for cholera. This does not exclude the infection of drinking water by the disease germ, since much of the drinking water used, as before stated, is drawn from the ground water. Pettenkofer, Buhl, and Virchow have shown that the death-rate from typhoid fever has a distinct and definite relation to the ground water oscillations. This has been incontestably proved for two cities, Munich and Berlin. When the level of the ground water is above the average, typhoid fever decreases; when it is below the average, the number of cases becomes greater.

Facts at present on record indicate that the stage of the ground water has an unquestionable relation to the sickness rate from intermittent fever. Malarial fevers are generally believed to be the invariable accompaniments of life in marshy regions, and so they usually are. But it is a noteworthy fact malarial diseases are neither most frequent nor most virulent when the swamps are full. It is in the latter part of summer and early autumn, when the water is being gradually evaporated, and the swampy soil is drying out here and there—when the decomposition becomes active—that the fevers begin. In the winter and spring, when the ground becomes saturated to the surface from the abundant precipitation, and the processes of decomposition are checked, the fever disappears or, at all events, the cases decrease in number and severity.

About twenty years ago Dr. Henry I. Bowditch, of Boston, called attention to the frequent connection between cases of pulmonary consumption and dampness of the soil upon which the patients lived. After a very extended and laborious investigation, Dr. Bowditch formulated these two propositions:

"First—A residence in or near a damp soil, whether that dampness be inherent in the soil itself or caused by percolation from adjacent ponds, rivers, meadows, or springy soils, is one of the principal causes of consumption in Massachusetts, probably in New England, and possibly other portions of the globe.

"Second—Consumption can be checked in its career, and possibly—nay, probably—prevented in some instances by attention to this law."

Dr. Buchanan, of England, about the same time showed that the thorough drainage of certain English cities had markedly diminished the deaths from consumption in the drained cities. So far as the writer is aware, not a single fact has been established which militates against the law laid down by Dr. Bowditch and as strongly supported by the statistical researches of Dr. Buchanan, yet hardly any notice has been taken of these results by physicians. Few know anything of them, and still fewer seem to have made practical use of such knowledge in advising patients. As corroborative of the views of Dr. Bowditch, the rarity of consumption in high and dry mountainous districts or plateaus may be cited.

V. Diseases of Animals Probably Due to Similar Conditions of the Soil.—The modern study of the sanitary relations of the soil is still in its infancy. Whatever definite knowledge has been gained relates merely to physical or chemical conditions of the soil and its atmosphere and moisture, or possibly the relations of these to the spread of certain diseases in human beings. But there is, perhaps, a wider application that may be made of such knowledge than has been heretofore suggested. The domestic animals which form such a large proportion of the wealth of this country—horses, cattle, sheep, and hogs—are liable to infectious and contagious diseases as well as human beings, and many millions of dollars are lost annually by the ravages of such diseases. Now, from what is known of such diseases as *splenic fever* among cattle, and of the so-called *swine plague*, it does not appear improbable to the writer that the source of infection is a soil polluted by the poisonous germ of the diseases, just as it seems demonstrated that chol-

era and typhoid fever, and possibly malarial fevers, are so caused. The laborious investigations of M. Pasteur, in France, have shown that the cause of splenic fever when once introduced into a locality will remain active for months and even years, and it does not seem out of place to suggest to the readers of this report, most of whom are interested in the preservation of the health of the domestic animals, and that a study of the soil in its relations to the diseases of these animals is a subject to which they may direct their attention with profit.

It is well known that milch cows frequently suffer from a disease identical in its nature with the consumption in human beings. It is believed by many that the milk of such animals is not only unfit for food by reason of its poor quality, but that it may convey the disease to human beings when used as a food. The observations of Bowditch and Buchanan, quoted above, show that consumption in man may be, and doubtless is, frequently caused by soil wetness. It seems probable that the same cause should produce similar effects in the lower animals, and it is the writer's firm conviction that an examination into the circumstances under which cows get consumption would prove this probability a fact.

VI THE PREVENTIVE REMEDY—DRAINAGE.—To secure a constant level of the ground water at a sufficient depth below the surface, drainage is necessary in many soils. Agriculturists know the value of proper and efficient drainage in improving the productive capacity of wet soils, but the men who build houses for human beings to live in, or stables to shelter animals, never give this matter much thought. Few of our architects have ever heard of the injunction of the ancient master of their craft, quoted in the beginning of this paper, to select a healthy soil upon which to build a dwelling, while a stable is frequently built partly underground, and in localities where all the conditions promoting disease are present. If farmers can once be made to understand that a wet stable, whether for horses, cows, sheep, or hogs, is an unhealthy stable, reform would soon be introduced. If they could be further convinced that a marshy or springy soil is not a healthy pasture ground, such places would soon be drained. If it were found, then, that by taking these precautions the health of animals was improved and their lives preserved, perhaps architects and builders in town and country would also learn that a dwelling cannot be healthy and comfortable unless built upon a clean, dry soil.—*Scientific American Supplement.*

Science for July 25th, announces that Dr. Chavanne, who is travelling on the Congo for the Brussels National Institute of Geography, has established a meteorological observatory at Boma. Mr. Stanley has transferred the site of his station of Vivi to a table-land some 1500 metres to the north; and a railway station from it to the Congo is being constructed. Another station, called Sette-Cana, has also been established at the mouth of the small river Sette.

ASTRONOMY.

VELOCITY.—II.

EDGAR L. LARKIN.

In this REVIEW for April we stated that a mass falling an infinite distance on a straight line, not meeting resistance, will strike the Sun with a velocity of 382.95 miles per second. It is almost impossible for a body to make a straight-line flight. The only instance is when a mass approaches on that tangent to the solar orbit on which the Sun is moving at moment of collision. The Sun traverses a path which analogy teaches to be a curve, hence moves in direction tangent to orbit. Construct a straight line from A to B, bisect it, place the Sun's centre at bisection, let it move towards B, and the line will be tangent. Let point of tangency always coincide with the center of the Sun—then will the points A and B and the tangent shift. Curvature is slight, arcs scarcely differ from straight lines for immense distances, thence—as the Sun moves, the tangent changes direction.

Assume space interspersed with comets, bolides and other masses having velocities in all directions determined by differences of attraction of suns. Midway—motion is slow—but none rest. Solar gravity in turn disturbs all bodies distributed in a tubular space whose diameter is twenty trillion miles, and length equal to that of the Sun's orbit; that is: dominates space whose radius is ten trillion miles on assumption that nearest stars have parallaxes of 1″, and masses each equal to the Sun's.

If the Sun and a stone be moving towards the same point from opposite directions in the same plane, and if at some epoch in the history of the stone's flight, its path becomes tangent to the orbit of the Sun at an instant when the Sun is in such position that the tangent A B coincides with the path of the stone, then collision will ensue, the stone reaching the Sun on a straight line—the only case possible.

Such combinations are rare, hence cosmical masses seldom make direct impact on the Sun, few reaching it with highest speed; that generated by fall from infinite distance. To find maximum velocity of impact we made G = square root of product of twice the Sun's gravity on surface multiplied by its radius, finding G to equal 2,022,008 feet per second. This velocity is that derived from fall from *infinite* distance. From *finite*,—V=G$\times$by square root of quotient found by dividing twice the distance less 1, by twice the distance. These formulas we find in standard astronomical works, and by using them in computation to extended decimals, it was learned that if a body begin to fall from 1,000,000 or 20,000,000r, the difference of velocities of impact will be 1 foot per second, thus:

Fall from Infinite Space=2,022,008 feet per second.
" " 20,000,000r =2,022,008 " " "
" " 1,000,000r =2,022,007 " " "

But 20,000,000r is nearly half the distance, to the nearest sun, while 1,000,000r is only 157 times the distance of Neptune. It follows that if a comet makes near approach to the solar surface on parabola or hyperbola, it cannot be determined whether it began to fall from distance equal to 1 or 2,000, for a body traversing a right line from 10,000r to the Sun will collide with velocity of 2,021,957 feet, and from 20,000,000r—2,022,008 feet per second, the difference being 51 feet, ratios of distances fallen being as 1 to 2,000. The comet of 1843 passed perihelion at a distance of—"One-fifth the Sun's semi-diameter," Newcomb and Holden's "Astronomy," p. 406. Calculating, using formula,—V=G ×by square root of quotient of distance divided by square of distance, we found velocity of comet at perihelion to have been 349.6 miles per second. But, it traversed a parabola and vanished from the solar system; doing so because its velocity was too great to permit it to yield to solar attraction and fall on the Sun; and because it was not moving on the line A B at epoch. Velocity and direction decided whether it disappear on parabola or fall on ellipse and make future circuits.

Its velocity—too rapid by forty-one per cent, evolved centrifugal tendency surpassing gravity, and bore it away on a parabolic curve. Making orbital velocity (V) when centrifugal tendency and gravity balance, we find V=G×by square root of quotient of distance from Sun's centre divided by twice the square of distance=247.2 miles per second. (Distance=1.2). Had the comet this velocity at instant of perihelion, it would have fallen into an ellipse whose major-axis would have direction determined by angle made with radius vector by the comet's path. With such velocity, and direction at a right angle,—then would comet have made future revolutions on a circle. The result 247.2 may be obtained with less computation, for 349.6÷1.4142=247.2; but this 1.4142 is the square root of 2; hence orbital velocity at a distance from the Sun's centre where centrifugal tendency equals gravity, is to fall from an infinite radius to that distance as 1 is to the square root of 2. Or,—velocity on a closed, as circle or ellipse, is to velocity on an open conic as parabola or hyperbola as 1 : 1.4142, an excess of .4142 velocity over circular or elliptical orbital velocity, being required to thrust a body beyond the solar system to a distance equal to that whence it begun to fall.

Place a cannon at right angles to a radius of the earth, fire a ball with a velocity of 4.90833 miles per second, and in absence of air, it will not fall, but revolve like a satellite. Elevate the ball to a distance equal to the earth's mean radius—3958 miles—and let fall; it will strike with velocity of 4.90833 miles per second.

The earth's distance from the Sun is 92,882,000 miles, and velocity 18.4927 miles per second.

Take a stone 92,882,000 miles from the earth, i. e. 185,764,000 from the Sun, and let fall. It will approach the Sun, but while passing the orbit of the earth, its velocity will be same as the earth's orbital motion. Therefore, spaces once fallen through by planets to acquire their velocities were equal to their present distances from the Sun.

The tangent A B slides round the solar orbit, the Sun forever moving towards B, hence most bodies approaching from that direction traverse paths making some angle with A B and cannot, therefore, make impact on the Sun. Their directions and velocities will cause them to miss the target and escape solar flames. Celestial bombardment is unskillful, cosmic missiles rarely hit the mark.

Towards B, may be termed front; A, rear,—then masses from front, not colliding with the Sun, will pass perihelion to the rear, and *vice versa;* while from other points, perihelia will fall at all distances and directions from the Sun's centre. Some astronomers hold that now, B is in right ascension 17h., and north declination 35°—the direction of solar motion. Bodies find it difficult to strike the Sun; few strike it at all, and less—with maximum velocity.

In this publication for May, 1882, we took this position and claimed that maximum heat of conservation of velocity seldom obtains.

Bombardment does not supply much of the Sun's heat. Most masses run down spirals making circuit often in retarding gases before colliding. Velocity must fall below 270.79 miles per second, which motion is then in direction tangent to the solar surface before cosmical masses richochet, This question of velocity is one of importance in astronomical researches, and worthy the attention of all.

New Windsor, Ill., July 17, 1884.

PROCEEDINGS OF SOCIETIES.

SCIENTIFIC PROGRESS.[1]

A. R. FULTON.

Like most institutions of a similar character, ours may seem to be of slow growth, but I have confidence in its ultimate success. Associations of this kind are not likely to attract the masses, for the reason that their objects are purely intellectual, and do not appeal to the emotional or sensational nature of men. Yet, by a careful investigation of the problems which nature presents for thought and study, we find enough that is marvelous, enough that excites wonder and admiration, to lead us very soon to feel the force of the declaration that "Truth is stranger than fiction." There are indications of a steadily increasing interest

1. An address read before the Iowa State Academy of Science, July 8, 1884.

in scientific investigation among people who are not professors in colleges, brought about mainly through the influence of such organizations as ours, and by the dissemination of popular scientific literature. There are departments of scientific research, such as those of geology, botany, and entomology, that do not require expensive apparatus, and all of these are full of interest and attraction for both old and young, especially after a limited understanding of their principles is once obtained.

For instance, in the comparatively new science of geology, you will find many people who are conversant with its leading facts and principles, as they have been demonstrated after the most laborious research. Even the school boy of to-day has his limited collection of fossils and minerals. He is able to classify them and explain as to what geological age his fossils and minerals represent. He learns from them how the world was made, and, by analogy, how other worlds are made. His mind expands to a conception of the forces of nature constantly in operation to bring about the wonderful changes which mark the different cosmical stages in the geologic calendar. The grand mystery of creation is unfolded before him as he descends in the scale from the age of man down through the ages of mammals, reptiles, amphibians, fishes, invertebrates and zooliths, to that of primordial vegetation, and thence to the azoic age, when no life, animal or vegetable, could exist, and when the earth was indeed "without form and void," as declared in that first great scientific essay, the authorship of which is attributed to Moses. I refer especially to the science of geology, because, as now developed, it comprehends some knowledge of what have in the past been treated as separate and distinct sciences, such as natural philosophy, astronomy, chemistry, botany and others.

No man can pursue geological investigation without learning something in all these departments of science. He must be something of a natural philosopher to ascertain and comprehend the causes, or forces, in nature which have resulted in the formation of the varied strata of which the crust of the earth is made, for he knows that every effect is the result of some adequate cause. He must know, or learn, something of the laws which govern the movements of cosmical bodies, among which our earth is but comparatively an atom in the universe. He will necessarily learn of the elements, and the chemical combinations which exist in the rocks and the minerals, of which the earth is composed. In the study of the fossils, animal and vegetable, which he finds in the solid rocks, imprisoned in what was but plastic matter so many long ages ago, perhaps millions of years, he will compare the conditions and forms of ancient organic life with those now existing, and which in turn, will leave traces of their history to be investigated by the geologist of some far future age. He must, therefore, become more or less familiar with the sciences known by the distinctive names of zoölogy, entomology and botany. Geology is, indeed, a science which may be termed composite, for it comprehends the elements of various other sciences. If you desire a student to enrich his mind with an extensive range of scientific knowledge, you cannot do better than to interest him in geology. Its fundamental principles

are as positively demonstrated as any problem in mathematics may be, while there is enough that is still theoretical and speculative to incite investigation, and this is not an unprofitable employment for the mind, for it is the source of all our acquired knowledge. The pursuit of scientific study brings the mind into nearer relation to the Supreme Power that has brought worlds into existence and guides all their motions, through the operation of immutable laws.

Our finite conceptions have never been able to comprehend but few of the mysteries of creation. We behold—we wonder—and man in all stages and conditions of his existence, has ever been striving to solve the great problems of nature. In the earlier and ruder ages of his history this longing to solve the mysteries of the physical and metaphysical led to the development of various systems of mythology, as those of the Egyptians, Grecians and Romans. Even the unenlightened tribes of this day have their myths and mystic ceremonies. The present generation of Pueblo Indians retain and practice the formulas of that nature-worship which has come down to them from their ancestors, who in the unknown centuries of the past, probably erected the temples and cities whose massive ruins have excited the wonder of archæologists. These are but expressions of that universal longing to know more of the mysteries of physical being. That principle, which is universal and eternal in the human mind, to know the relations and the causes of things, dwells with the savage as with the sage. The ancient Hellenic mind invested the mountains, valleys, plains, and seas of Greece with deities, all under the supreme rule of Zeus, the victor in the Titanic war, who established the seat of his power on Mount Olympus, and controlled the lesser deities, which Grecian polytheism or imagination had conceived as having subordinate control over the various elements of physical nature, as well as human passions, thought, and action. Every deity in their mythology but personified some phase of mind or matter, which the science of that magnificent people could not explain. In obedience to that principle of the human mind to which I have referred, a desire for knowledge, they sought to solve the mysteries of the universe, and our higher and more exact knowledge is but a stage in the upward progress of the grand march of human investigation.

The adequacy of the science of to-day to explain many of the phenomena of physical nature has been a most potent factor in releasing the human mind from the thralldom of superstition. The occurrence of an eclipse of the Sun or Moon is not now regarded with dread, or as indicating the anger of the gods. The astronomer, or the mathematician, is competent to foretell, without the gift of prophecy, every obscuration of those bodies, total or partial, for a thousand years to come. To us a November meteoric shower is no evidence of a war raging among celestial beings, nor does the comet that blazes athwart the heavens inspire in us any terror for the wrath of a displeased deity, threatening destruction to nations and rulers. The tornado's wrath may be terrible, but we know it sweeps down upon us in obedience to some elemental law, and is not the dread messenger of any supernatural agency. The rainbow does not come to us with messages from Olympus, nor as a goddess to cut the last thread that binds the

soul to the dying body, as in the really beautiful and exquisite myth of Iris; but it is simply the different colors of the spectrum, brought to view by the refraction and reflection of the Sun's rays in drops of falling rain. While it may be that the highest and noblest aim in the pursuit of scientific study is not mercenary, it is not to be denied that science has added vastly to the world's material wealth.

When Werner in Germany, and Hutton in Scotland, near the close of the eighteenth century, became the founders of opposing theories as to the origin of the strata of the earth, each doubtless pursued his investigation with little thought that he was giving an impulse to that which was soon to develop into a science, from which the world was to derive vast economic benefits. These fathers of the science of geology wrought for the purpose of discovering facts which had hitherto been hidden from men. Their reward came from that pure gratification which results from the pursuit of science for the love of it, while the great mining and agricultural communities of the world are to day receiving the economic benefits of their researches A large proportion of the scientific discoveries of the present age are utilized in the various departments of human industry. The application of steam, electricity and the laws of chemistry to various economic uses are examples of what science has done and is doing to promote the material welfare of man. In all the operations of nature there has been a continued succession of cause and effect, and the very last effect of any given cause runs back in an unbroken line to the *very first cause*. There is, *in fact*, not a single missing link in the great chain of nature's course, reaching back through the million of ages to the unknown time—"In the beginning." There are links in this unbroken chain which have not yet been revealed to the eye, or to the understanding of man. It is the province of science to discover them—to search out the truths which exist in nature, which have been heretofore unknown to us. All the facts and possibilities which science has revealed respecting electricity may have existed as fully and completely a thousand, or ten thousand years ago, as now, but there had not yet been born to science a Franklin, a Morse, an Edison, or a Phillip Reis. Nature held within her repository all the unwrought materials and elements required for the construction of the steam engine long ages before science discovered the means of applying to practical use this wonderful agent which now acts in obedience to man's will. From spinning the most delicate silken thread to drawing the freighted train, or propelling the mighty steamer, who can estimate the work of this servant of man? In every part of the world where civilization has established itself, this mighty force—this modern hercules of science —is the agent of man's will. The steam engine has revolutionized the industrial world, and added immensely to the material advancement of the race, while electricity is employed to bring the nations of the earth into hourly speaking relations. A great political assembly in Chicago names a citizen for the highest office that the suffrages of the American people can bestow, and before the presiding officer of the convention can restore order, broken by the shouts of rejoicing in the great building by the lake, the lightning has flashed intelligence of the result

to the people of London and Liverpool, and almost as quickly the news is read in different languages in Paris, Berlin, Vienna, Rome, and St. Petersburg.

Another of the triumphs of modern science enables man to hold verbal communication with his fellow man, though separated by hundreds of miles—to recognize the very intonations of the voice of his friend, as if conversing face to face. These are but a few of the grand gifts of modern science to the commercial, intellectual and social world. There are many others, as in chemistry applied to agriculture, medicine and the arts. In the secluded quiet of the laboratory men like Pasteur are daily searching out and bring to light the hitherto hidden secrets of nature, and are contributing their discoveries to the constantly accumulating store of human knowledge and human blessings. We, as an Academy, or as individuals, may add no original discoveries to the sum of scientific knowledge. We may, however, have our thoughts and views enlarged by being interested observers of the truths which science has revealed, and which are constantly coming to light in its onward progress. It may be the good fortune of our humble Association, as it grows in strength and influence, to impart to some youthful mind the inspiration that may develop into important scientific results. All must concede that our purposes are of an elevating character, and our Society such as all thoughtful people must commend, even if they do not take an active interest with us. Every young person who attends a meeting of the Academy comes with a higher and nobler purpose than that which would prompt him to attend an ordinary amusement or pleasure resort. Our Society has been very economically managed. We are not in debt, and have, I believe, a small balance in the treasury. We need funds, however, to make provision for our collections, and for such contributions as are being made from time to time. We should also be able to support an occasional course of public scientific lectures.

Des Moines is rapidly advancing in population and wealth, and although its leading citizens are largely engrossed in money making, many of them are not indifferent to things which tend to intellectual advancement. Who knows how many such might be induced to become life members of this Academy, if for no other reason but to give assistance and encouragement to a commendable institution of the city?

And now, fellow members of the Academy, hoping that all of us will work together for the realization of our highest ideal, and thanking you for your confidence as expressed in calling me for another year to preside over your deliberations, I conclude this paper.

THE HISTORY OF THE TELEPHONE.

Mr. E. Berliner, well known to those of our readers who are versed in telephonic matters, has sent the following communications to the *Electrical World*. This gentleman's remarks concerning Bourseul will doubtless be specially interesting to one of our most distinguished scientists who has so warmly espoused the cause of Reis.

Mr. Berliner says:

The general impression having at all times been that Reis was unacquainted with Bourseul's ideas relating to the electrical transmission of speech, and that he was an original inventor, the following article from the *Didaskalia*, a semi-weekly printed in Frankfort-on-the-Main (the abode of Reis from 1848 to 1854), a paper devoted to belles lettres, arts and sciences, and which in its time had a large circulation throughout Middle and Southern Germany, will be interesting to all electricians.

The article is from the 32nd volume of the *Didaskalia*, in No. 232, and the issue bears the date Thursday, September 28, 1854.

The undersigned has prepared a verbal translation of this remarkable document, and through the kindness of the editor of this paper has commented on it in another column of this issue.

E. BERLINER.

DIDASKALIA. 32nd volume. No. 232. Frankfort, September 28, 1854. *Electrische Telephonie.*

The wonders with which electricity has surprised us lately will, as it seems, be augmented by a new one which will not only produce a revolution in the present electrical telegraphy, but will also enhance its utility in an incalculable manner. It concerns nothing more or less than the electrical transmission and rendition of the *spoken word.* The idea originated with a young and modest but educated man, Charles Bourseul, who in 1848 was a soldier of the African army, where he made himself observed to the Governor-General by a mathematical course which he gave to his comrades of the garrison in Algiers; he now lives in Paris. Perhaps Bourseul's problem, of the feasibility of which he is perfectly convinced, belongs to the line of those discoveries which the learned world afterward declares as very simple, and of which they would then make us believe would have been found out much earlier if they would have taken the trouble (to find it). As we know, the principle on which electro-telegraphy is founded is the following:

An electric current circulating in a metal wire transforms a piece of soft iron with which it comes in contact(?) into a magnet. As soon as the current ceases, the magnetic quality gives way. This magnet, the electro-magnet, can therefore alternately attract and let go a movable plate which, by its motion of coming and going, produces the conventional signs which are used in telegraphy.

It is furthermore known that *all* tones are communicated to the ear merely by undulations of the air, being, therefore, themselves nothing but these undulations of the air, and that the differences (without end) of the tones depend solely and exclusively on the rapidity and the strength of these sound-waves. If, now, a metal plate could be invented so movable and flexible as to render all the tone undulations equal in the air, and if this plate be so connected to an electric current that it would alternately make and break the electric current according to the air undulations by which it is struck, then it would be possible to cause a second similarly constructed plate to electrically repeat at the same time exactly

the same undulations as the first plate, and it would therefore be the same as if a person had spoken in the immediate neighborhood against this second plate, or the ear would be affected in the same manner as if it received the tones communicated through the first metal diaphragm (*mettallwand*=wall, partition, E. B.). The electrical telegraphy which at the time was stamped, academically, almost as nonsense, now traverses the whole world as a familiar phenomenon. If we consult, in regard to this new idea of a young physicist, the principles of physics, we have not only nothing to say against the possibility of its execution, but its success seems more probable than did electrical telegraphy not long ago.

If the experiment succeeded, then electrical telegraphy would have become quite good; it would require no other machinery and knowledge than a galvanic battery, two vibratory plates and a metal wire; without further preparation one person would have only to speak against the one metal plate and the other person to hold his ear to the other, and thus they could converse one with the other as under four eyes (*unter vier augen*=personally).

The young inventor believes in the success of his endeavors, and challenges the learned men to prove that the laws of physics are in contradiction with the above recited principles, and that they let appear impossible what is looked for.

In the meantime this matter would deserve the attention it will receive, in the highest degree.

(Signed), L.

—*London Electrical Review.*

METEOROLOGY.

METEOROLOGICAL DISCOVERIES.

ISAAC P. NOYES.

Discovery is the act of obtaining facts in regard to any subject. The great discoverers of the world are they who have ascertained facts in relation to the conditions of nature. The higher the type of the discoverer the more cause and effect will enter into his composition, and the more his work will reveal it. Not only will he seek to discover facts, but also the relations which these facts bear to each other and the results of their influence upon the forces of nature. No matter how capable a discoverer may be, no matter what his powers of mind and body, he is more or less hampered by his surroundings.

The globe on which we live, even at this late day is not entirely discovered, and although the undiscovered portions are comparatively small, no one at present can tell what influence their discovery will have upon the human race.

Although the world was highly civilized and had, centuries ago, made astro-

nomical discoveries, whereby it knew about the heavens, and geographical discoveries, whereby it knew of the earth, up to within a very late period it knew little, comparatively nothing, about that great stratum immediately above us, which we term the atmosphere. Until we had a Weather-Map, covering considerable extent of territory, it was impossible to obtain such data as would put us in the way of acquiring the necessary information. It may be asked, why we did not have this map at an earlier day? We might ask, why the "Western Hemisphere" was not discovered at an earlier day, why it was that the civilized world did not sooner learn that the earth was round? Indeed, in this line we might ask pertinent questions by the score. We would get but one general reply —the world was not prepared to obtain this knowledge sooner than it did,—the upper stories of a structure cannot be built before the foundation and the walls of the lower stories are completed. The perfection of meteorology, whereby we become familiar with that stratum of nature between the heavens and the earth, depended upon the perfection of other things which lead up to it. Years ago when we studied physical geography we thought that we knew, or must know about all that there was on this subject.

Wise men had given it their studious attention, but studious attention was of little avail without the means of obtaining facts all important in the matter. Other able men must first advance in the department of electricity and perfect that, give us the telegraph and all the other necessary paraphernalia for gathering the important facts, whereby the transmission and the use of data was made practical. Wonderful are all the necessary perfected steps which lead up to this important branch of human knowledge; indeed do they come under the head of "too numerous to mention." The clear intellect, even with the unaided eye could obtain a very complete knowledge of the heavens. By the aid of ships, and a few instruments, whereby the unknown seas could be navigated, we could discover the unknown continents, but in order to discover these regions which lie between the heavens and the earth—between the celestial and terrestrial spheres, we must wait many long centuries until we had so subdued the forces of nature to our control that we could use them to conquer these other forces which were apparently beyond our reach. But step by step we were lead up to them, and to-day, through these acquired agencies, the laws which govern the forces which form this middle domain of nature and which have such an influence upon us, are as well known as the terrestrial conditions with which we are so familiar; that is, we are, or can be familiar with them on the same principle that we are familiar with other things about us—by seeking information in the right direction and from the right source. "Where may this be found?" it may be asked. On the Weather-Map. The Weather-Map followed up day by day. will reveal all to us; and it is the medium and the only medium whereby we may understand this subject.

"But what about physical geography?" may be further asked. Physical geography most certainly should embrace meteorology, as a department embraces a bureau, but meteorology up to within a few years, had no knowledge of the Weather-Map—indeed even late editions of physical geography make no

mention of the map, and yet this wonderful instrument has been in existence, here in the United States since 1870. At first, however, it was necessarily crude, but about 1876, or thereabout, it had reached quite a degree of perfection, and yet the persons whom the world would have thought would have been the most eager to seek revelations from it were the very ones to neglect it and continue to publish works upon the general subject, "physical geography" with little or no attention to this all important branch which alone can impart the necessary information.

Physical geography so far as it pertains to meteorology, without the knowledge that may be derived from the Weather-Map, is comparatively of no value, and at this age of the world better be dropped altogether.

The Weather-Map is a most peculiar thing. It does not reveal its secrets like a book, or even like a picture; for this reason few pay much attention to it, and therefore fail to see and perceive the wisdom that it imparts. It must be followed up, day by day, week by week, month by month, year by year; and as it is never twice alike—always different—showing the dominant force in nature for the time being, these forces never bearing the same relation to each other—man can study this wonderful Geography of the Atmosphere for all time, and to the end of time continue the study; and then, after all this study, the changes which take place will be as new and fresh to him as the next new face he meets in his daily walk. Although physical geography should include meteorology, by reason of the map, the sub-department becomes independent and all important by itself. We will study physical geography when we wish to know about the terrestrial conditions which surround us but when we wish to know something of what we may term the middle stratum, the bridge between earth and heaven, we will consult the Weather-Map. This is speaking of things as we find them to-day. The physical geography of the future, however, will include this. The great wonder, however, is that those who are authors and publishers of physical geography have so long ignored so much light, and the only medium whereby light and information could be gained on so important a subject. All persons should be informed in regard to the Weather-Map, and all intelligent people should be able to know something practical about a storm, when it is approaching, from what quarter, when and how it is likely to clear off, and more than this, should be able to protect themselves against all impostors, and all silly, erroneous, and superstitious sayings on this subject. And, by-the-way, there is no department of nature so replete with these sayings, as the weather, for the simple reason, as seen in all departments of human knowledge, where there is darkness then will there be all degrees of foolishness, from the harmless to that which is most injurious. When man has no real knowledge he readily resorts to the imagination, and the lower his nature and the greater his ignorance, the lower his conceptions of cause and effect.

The Weather-Map with its wonderful revelations came late to the world, yet the authors of our physical geographies should have been ready to receive it when it came, but they were not. Their influence by this time might have added

much light and corrected many wrong impressions, but they choose rather to ignore the light than to seek it and profit by it.

To-day, meteorology is still taught, or better, attempted to be taught, on the old plan; might as well undertake to teach pupils geography with the books and light of the fourteenth century as to attempt, to-day, to teach them meteorology without the Weather-Map. The reader may think I am too eulogistic and simply trying to "write up" something beyond its value. All I have to say to such as may think so, is, to study the map thoroughly and note its revelations day by day. Before taking the map, however, let one ask himself what he knows about the weather. After a careful study of the map for a year or two let him compare notes with what he then knows, and what he knew before. If the map has not revealed his former ignorance then he has not been a good observer and made the best use of his time. The great important thing the map reveals to us is that the areas of high and low barometer move across the country on general lines from the west towards the east. "Low," or low barometer is the governing factor, and may be likened unto the valley, while "High" represents the hill. The currents of atmosphere are from the "High" to the "Low." The cause of low-barometer we ascribe to concentrated heat. The great property of heat is to expand or rarify the particles of matter with which it comes in contact. The air at the point "Low" is rarified: the result of this is the inrushing of cold currents to supply the place of this air so rarified and makes what we call *the wind.* So the movement of atmosphere is always towards "Low." The great reservoir of air is the area of "High" or high-barometer. The air rushes along the surface of the earth, from all points of the compass, from "High" towards "Low"; here, by the force of heat, it ascends till it reaches the upper stratum of the atmosphere. From here, judging from the upper movements of the light clouds, the direction is outward from the centre "Low" towards the "High," or better, the upper part of the column "High" to supply the withdrawing of the atmosphere from the bottom of the column "High."

The surface current, or what we term the wind, is, on general lines, from "High" to "Low"—the upper or atmospheric currents from "Low" to "High." At the surface of the earth from the cold to the hot, at the surface of the atmosphere from the hot to the cold—the vacuums as it were being reversed. On the surface of the earth "High" is the highest, "Low" the lowest, while at the top, or upper stratum of atmosphere the highest point would seem to be at "Low"—"Low" the highest, "High" the lowest. When we speak of the movement of the atmosphere, its movement along the surface of the earth, or its terrestrial movement is to be understood. The movement is from the "High" to the "Low." This being the case if "Low" is on a high line of latitude, say at 50° north, or beyond, we will have south winds; and south winds are warm; that is, winds from the far south; the further they are from the south, and the further they travel over the country, the warmer they become. That is why it is, in summer time, often warmer along the northern line of the United States than at the south. But although these areas of Low-barometer travel from the west

towards the east they do not do so on any regular line or course. They enter the territory of the United States at various points. On the Pacific their most objective points are above and below Cape Mendocino, the extreme western point of our western border.

This, however, is a mere general statement, for they never enter twice alike and vary with the season and seasons. As a rule they enter and cross the country on a higher line of latitude during the warmer than during the colder months. Others enter at the southwest, or through Mexico and Texas; while still others enter from the region of the West Indies, sometimes striking quite far inland; at other times merely skirting the coast. These latter ones, from want of stations in the West Indies we have very little forewarning of. Although "Low" travels from the west towards the east, it often in its passage, travels on lines almost due north and south for twelve or fifteen hundred miles, and perhaps more. For want of the proper stations we cannot trace its full course. So these "Lows" that come up from the south are undoubtedly ones that are travelling on some erratic course. These areas of high and low-barometer, "High" and "Low," in addition to travelling as above stated, also travel in belts around the world, and all the while vary as to the territory they cover. At times "Low" will be in the north, "High" central, and another "Low" in the south; or we may have "Low" central, with "High" each side. It is always changing, and these changes produce the changes of the weather from hot to cold, wet to dry; and all the changes are the result of the relation which these two powers "High" and "Low" bear to each other.

The wind being towards "Low," it follows if "Low" is in the north we will have south winds, if in the south, north winds, and these winds partake of the qualities of the locality from which they come. There are times, however, when the north winds will not be very cold nor the south winds very warm, and this will be when these respective winds come from an area of high-barometer that is not very far away. If "High" lies immediately to the north, the north winds cannot be from a great distance north, and if "High is immediately to the south the south winds will not be from far south, therefore will have little opportunity to become heated. "High" is like a great mountain ridge; it is the mountain ridge of the atmosphere. The wind is from the centre of the ridge or highest point of "High;" from the centre outwards, so on the north side of "High" the wind will be towards a north "Low," while on the south side it will be towards a south "Low," etc.

The lines which these areas of "Low" make across the country are infinite, never twice alike; and although their general course is from the west towards the the east, or towards the rising sun, they at times travel due west, but it is always towards the latter part of the day or at night. So soon as the sun reappears in the east and establishes its centre of heat "Low" immediately advances towards it. These areas of Low-barometer not only vary in direction, but in speed, extent and intensity, sometimes being very small, not more than a few hundred miles in diameter, then extending over one-half of the United States and at times

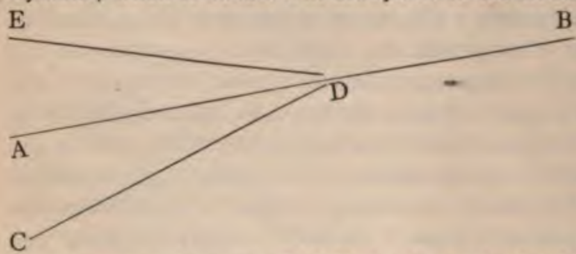
they travel not more than a hundred miles in twenty-four hours, at other times they will travel fifteen hundred miles in the same time. And herein is the trouble as regards "indications." We cannot, at least at present, know in advance the direction, the intensity, the speed or the spread, the storm-centre "Low" will take; it is never twice alike nor does it have any periodic similarity. In meteorology there are no special rules to guide us, and that which is past does not, only in a general way, help us much as to what is to come. The study of the map, however, is far more satisfactory than any "indication." But the map can only be studied with satisfaction when near at hand. We can, however, with slight cost, have a substitute which will be nearly as good, and far better than none. The substitute is a skeleton map. Let the people throughout the country have rough outline maps of the United States, divided into squares on the lines of latitude and longitude. Let the size be regulated by convenience. The squares to be designated by letters or figures. The report then to be sent from headquarters at Washington; not only once a day, but say at morning, noon and evening, indicates where the "High" and "Low is, their number, (if more than one), direction, and movement since the last report. Let the public once get accustomed to this system and they would not think of relinquishing it, nor of turning back to even the present system, much less to the ante-diluvian *no-system* which we received from the old school of "physical geography." The new school of physical geography will embrace the "Weather-Map" as its all important source of information in this department.

As the storm-centres "Low" appear in our west and disappear off the eastern coast and are tracked across the ocean to Europe, so far as we know always disappearing in the east, the inference is that they encircle the earth. We cannot at present prove this, but as we can trace them a quarter the way around the earth and they disappear and reappear in this manner it is not unreasonable to believe that they encircle the earth. The question is often asked, where do storms come from? This idea of encircling the earth being true they do not come from any specified place or quarter, and have no more beginning or ending than a circle, and of them it may well be said, they come from *nowhere*, if the phrase may be understood to conform to the statement in regard to their course and origin. They are ever present on the surface of the earth, varying in shape, in size, intensity, compass and direction, but always having an existence, ever coming and ever going. Late in the season, when we have what is termed "settled weather," as many storm-centres pass us by as during the "inclement season," but they pass us on different lines. During the warmer months a greater number pass us on a high line of latitude and carry heat far to the north, making the north country productive.

Before the advent of the Weather-Map we could not understand that marvel of the year "Indian-summer." The map shows us that it is the effect of an autumnal "Low" on a high line. During the colder months more "Lows" travel on low lines of latitude, making it cold at the south. The "Lows" that produce the most storm, rain or snow, are those which travel on diagonal lines.

Whether "Low" will produce rain or snow depends upon its latitude as well as upon the season and the latitude of the section of the country over which it passes. To enumerate all the changes of "High" and "Low," and to show the effects which they have upon the climate of the country would fill volumes. As the changes are infinite the variety must be in proportion; only by the Weather-Map can we be aware of these changes and study their effects. Until we had this wonderful map we had little or no conception of the meteorological phenomena of the world. For example the tornado. The old "physical geography" system had various names for this violent phenomenon, such as *cyclone, hurricane*, and *tornado*, and undertook to draw a line between them, giving certain characteristics to one which it did not give to the other. The map reveals the fact that they are all one and the same, and that they proceed from "Low," and under certain conditions of "Low" the different localities of the earth will have the severe storm which may be called by either of these names. The mere description of one of these storms might fill volumes, but from them we gather little or no knowledge of their cause, we only learn of the effect, but follow up the Weather-Map and their cause as well as their effect will be fully revealed. The tornado comes from "Low" and always takes place in the track of this factor, which for short we term "Low." One "Low" passing over the country will not produce the effect, any more than a little fire would in a short time heat a large room. We must have a succession of "Lows" on a high line, or relatively high line, in order to obtain, through the south winds, the necessary amount of heat. Every "Low," even *high* "Low," will not produce a tornado, if it did we would not only have one every day but every hour of the day all over the country.

The map reveals the fact that the violent wind-storm we call Tornado or Cyclone, when it occurs will always be in the track of "Low" and generally at



an acute angle thereto, say an angle of about 15° or 20° to the line of the track of "Low." Let the centre of "Low" one morning be at A; the next morning at B. The tornado will take place on the line C D or E D, or even between the angle C D E, in the track of "Low."

Volumes have been written upon the subject of Climatology, but the subject will never be understood until we seek the proper information from the Weather-Map. By this map we can understand the Climatology of the United States as never before, and when the rest of the world is as well supplied in this respect as the United States we will then and not till then understand the full climatology of the world. The climate of the eastern and western coasts of continents is quite different. Under the old system, which is still present with us, this is all said to be due to the warm currents of the ocean. But the "Weather-Map"

now steps in and reveals additional light; and, while at present, from want of stations, we cannot deny but what the warm ocean-currents have something to do with the mildness of the climate, say of our northern Pacific Coast, it does reveal to us that it is not all owing to these currents, but that the position of "Low" has much to do with it and perhaps more than ocean-currents. Land retains heat better than water. To the north of the United States there is a vast domain of land. The map reveals to us that one belt of "Low" passes far to the north of Cape Mendocino, and that the line of this belt varies with the seasons, while the currents remain about the same the year round. Now if the currents remain stationary and the course of "Low" varies with the season it would seem to be good proof that this phenomenon was independent of these currents. This same phenomenon reveals the cause of the peculiar climate of California; a revelation that was not in the power of the old physical geography system to make known. From early in the season till towards the winter months the north "Low," the one that enters the coast to the north of Cape Mendocino works far to the northward. The one that enters the coast to the south thereof also advances northward. From winter to spring these two belts work southward with the Sun. The higher the Sun in the ecliptic the higher the belt of "Low." "High" lies between these two belts and a good part of the year is over the region of San Francisco. The course of these belts varies, for this reason the seasons of this section of the country vary and are never twice alike; but as a rule "Low" passes over this locality quite often from December to April. The higher the Sun in the ecliptic the higher the line of "Low," and the higher the line of "Low" the warmer the temperature on a high line of latitude, and the reverse. Until we had this new revelation it was not possible for us to understand these phenomena of nature. By these discoveries, which come through years of patient toil and advance towards perfection in other branches, we are able, as never before, to comprehend the system of nature under which we live.

Of course this system comes generally under the head of physical geography, and physical geography should include meteorology as a department includes a bureau. But the department, strange to say, has ignored the bureau, and the perfection of the bureau has come through sources quite unlooked for; and though disregarded by the department has quietly advanced towards perfection most surprising. It would be wise in the department to now accept the bureau. As the case stands at present the bureau has fast exceeded the department—a most peculiar circumstance in the annals of science.

It is to be hoped that more and more attention may be paid to this subject. What meteorology now calls for is more and more stations in localities where they will be of the most value. The more we have the more valuable the system becomes, and it would seem that it was time the nations of the earth took this subject in hand. The more universally it is extended the greater the blessing it will confer upon all, the small territory as well as the large, the large as well as the small.

The great middle stratum of our universe is what we particularly want knowl-

edge of. We want to understand the geography of our atmosphere as well as the geography of our terrestrial globe and that of the distant heavens. On this knowledge depends more blessings than is at present realized by the world. The little instrument known as the "Weather Map," strange as it may seem, is destined to play a most important part in the welfare of the race. The more we contribute to the knowledge of this great undiscovered country, between earth and the heavens, the more happiness we confer upon ourselves. Let the lines of stations advance until we have at least one on a square of two hundred miles—the more we have the better the work, and the greater our knowledge on the subject, the wiser and more reliable weather-prophets we may become, and the greater the blessing we may confer upon mankind.

WASHINGTON, D. C., July, 1884.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	June 20th to 30th.	July 1st to 10th.	July 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	68.	62.	66.	..
Max	96.	85.	97.	..
Min. and Max	82.	73.5	83.	..
Range	28.	23.	31.	..
TRI-DAILY OBSERVATIONS.				
7 a. m.	72.4	71,3	71.7	71.8
2 p. m.	86.5	87.0	84.8	86.1
9 p. m.	73.2	75.4	75.4	74.7
Mean	77.4	77.4	76.4	77.1
RELATIVE HUMIDITY.				
7 a. m.	.89	.80	.88	.86
2 p. m.	.69	.55	.70	.65
9 p. m.	.85	.77	.85	.82
Mean	.82	.71	.81	.78
PRESSURE AS OBSERVED.				
7 a. m.	29.034	28.965	29.023	29.004
2 p. m.	28.990	28.948	28.991	28.976
9 p. m.	28.993	28.949	29.020	28.987
Mean	28.006	28.954	29.011	28.989
MILES PER HOUR OF WIND.				
7 a. m.	..	9.8	..	..
2 p. m.	..	12.6	..	..
9 p. m.	..	7.5	..	..
Total miles	1630	2413	1964	6007
CLOUDING BY TENTHS.				
2 a. m.	4.4	4.7	4.6	4.6
7 p. m.	4.7	2.5	4.5	3.9
9 p. m.	2.6	3.0	4.3	3.3
RAIN.				
Inches	2.29	1.78	2.73	6.80

th included in this report has been warm and moist. While the ot much exceeded the average at this season the previous saturated he soil has made it seem unusually wet. To this humid condition erature has added a feature which has made the air quite oppressive , still nights have not given the usual chance for refreshing sleep. storms most of them have occurred at night in the latter part (i. e. 3:00 o'clock A. M.), and at this station they have come from the rtheast. There have been abundant electric disturbances, and the strong but not reaching the tornado violence.

g struck in many places, doing some damage. These conditions the growth of corn and no one has ever seen it grow more rapidly, as.

BOOK NOTICES.

THE THIRTY YEARS' WAR: By Anton Gindely. Two volumes; pp. 912; Illustrated. G. P. Putnam's Sons, New York, 1884. For I. H. Dickinson, $4.00.

k, notwithstanding its dimensions, is a condensed history of the war ween the Roman Catholics and Protestants in the first half of the commencing in 1618, with the insurrection of the Bohemians, and he peace of Westphalia in 1648. It is divided into three parts: cribes those events which gave immediate occasion to the out-break oceeds thence to relate the history of the Bohemian insurrection, oceedings and confiscations which follow, and the consequent re-asures of religious reformation. It is doubtless the most reliable ne time interesting account of this celebrated struggle that has ever for aside from the mere facts of history the author devotes many unts of prominent individual actors in the drama, such as Gustavus rdinand II, Cardinal Khlesl, the Palsgrave Frederic, Maximilian of ce Waldstein, and Cardinal Richelieu. These portrayals of life are uable as showing the peculiarities of the intercourse between the time.

ssion of the subject is full and free, and enables the reader to rightly posing characters as the Romanist Ferdinand II of Bohemia, and unrelenting protestant, Gustavus Adolphus of Sweden, who devoted to carrying forward the principles of his church and faith.

le war seems to have been, with the exceptional ambitions of various contest for the control of the religious doctrines and worship of the t regard to the feelings and wishes of the people themselves. Both

sides shared this idea and were equally intolerant of sects that did not agree with either.

This war commenced just a century, or, to be exact, ninety-eight years from the date of Luther's nailing his theses to the church door at Augsburg, and was the natural outgrowth of the revolution led by Huss and his fellows. The evolution of religion and religious beliefs and doctrines has steadily proceeded through all history and will continue to do so until the grand final culmination is reached, which no man can foresee, and this terrible war was but one chapter in the course.

The typography, paper and binding of these volumes are excellent.

TIMES OF LINNÆUS: By Z. Topelius. 12mo., pp. 394. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson, $1.25.

This is the fifth of a series of Swedish historical romances by Prof. Topelius, of the University of Finland, entitled "The Surgeon's Stories," those preceding it having been "The Times of Gustav Adolf," "Times of Battle and Rest," "Times of Charles XII" and "Times of Frederick I."

The marked characteristics of these works are the enthusiasm of the author and the correctness of his portrayal of prominent actors and events described in them. Of the volume under present consideration, it is perhaps less exciting in most respects than either of the others, but at the same time, it is full of interest and instruction concerning the period involved. It is divided into two parts "The Princess of Wasa" and "The Free-Thinker." In the first, as the author suggests, "A glance is cast at the inner side of the middle of the eighteenth century, with the whole bubbling cauldron when the ideas of a new period were boiled soft, to be eaten scalding-hot by the revolution of 1789—the time of Adolf Frederick, Louisa Ulrica, Tessin, and Linnæus, the childhood of Gustav III and the period of the hoop-skirts." Linné, the great naturalist, afterwards Latinized to Linnæus, makes the subject of a chapter or two, otherwise his name is not mentioned. In the second he does not appear at all, but other characters of the time make up the story.

One more story completes the series. It is entitled "The Times of Alchemy," and will doubtless equal any of its predecessors in interest.

THE ELEMENTS OF RHETORIC AND COMPOSITION: By David J. Hill, LL.D. 12mo., pp. 270. Sheldon & Co., New York and Chicago, 1884. For sale by M. H. Dickinson, $1.00.

Dr. Hill is a well known writer of text books on rhetoric and logic, having published treatises on each of those subjects for use in the schools, as well as other similar works. The present book is designed as a practical introduction to English composition, and to furnish a compendium of rules for guidance in the art of writing. The learner is conducted, step by step, through the entire work

of writing a composition, including the selection of a subject, the accumulation of materials, their arrangement, the choice of words, the construction of sentences, the variation of expression, the use of figures, the preparation of manuscript, the criticism of the completed production, and the classification of it as a specific form of composition. The exercises are full and carefully prepared; a copious index and glossary are also found. The whole work is better adapted to the class-room than most books of the kind, and we should like to see it adopted as a text-book in the schools of this State.

A COUNTRY DOCTOR: By Sarah Orne Jewett. 12mo., pp. 351. Houghton, Mifflin & Co., Boston. For sale by M. H. Dickinson, $1.25.

This, the first continued effort at novel-writing by Miss Jewett, is a decided success. Her previous works have been confined to short stories which have attracted much attention and have been read with interest by all readers. The plot of the story is simple though well constructed, and the characters and incidents faithfully drawn. Being a doctor's daughter she has been able to weave in many familiar incidents of a doctor's life and to give to her heroine, who becomes "the country doctor" of the story, a reality of character and conduct not often found in a young lady's book. The tone of the work is healthful and the style free and attractive. It can but have a good influence wherever read.

BARBARA THAYER: By Mrs. Annie Jenness Miller. 16mo., pp. 180. Lee & Shepard, Boston, 1882. For sale by M. H. Dickinson, $1.00.

Mrs. Jenness is well known in the east as a former popular lecturer, who since her marriage has taken to the congenial pursuit of novel-writing. This is her first work and it seems to have been unusually well received. The author has carried into the book her best thoughts in the line of her platform teachings, which were always devoted to social and educational topics. She is earnest and decided in her treatment of the marriage question, and handles some very delicate points in a decisive and frank manner, at the same time with great natural refinement. All of the characters are carefully and skillfully drawn, and whether we fully agree with her or not in the disposition of the case, we must all admit that her ideal is lofty, and that she maintains her point faithfully and with firmness to principle throughout.

SCIENCE LADDERS: By N. D' Anvers. 12mo., pp. 439. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson, $1.50.

This volume is made up from the series of six smaller ones which we have noticed as they were published separately under the titles respectively: "Forms of Land and Water," "The Story of Early Exploration," "Vegetable Life,"

"Flowerless Plants," "Lowest Forms of Water Animals," "Lowly Mantle and Armor-Bearers." The series is intended to teach the great laws of nature in language simple enough to be intelligible to every child and yet with accuracy and completeness. It aims at awakening the powers of observation and reasoning so that pupils and teachers may be fellow-workers from the start. How well these objects are carried out can be judged from the titles of the different papers, and the fact of the series having had a large and wide-spread sale.

FIFTH AVENUE TO ALASKA: By Edwards Pierrepont, B. A., with maps. Octavo, pp. 329. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson, $1.75.

This is a vivacious and sketchy account of a four months' trip by rail, steamer, stage and on horseback from New York to the Pacific coast, up that coast to Alaska, "reaching a latitude where there was no night and where the Sun rose within four hours after he set." Thence by way of Victoria and Puget Sound to Portland, and then home by way of the unfinished Northern Pacific R. R., making some twelve thousand five hundred miles in all.

As the son of Hon. Edwards Pierrepont the author had unusually good advantages for seeing all that was worth seeing, and especially of meeting with many intelligent and dintinguished men who were free to impart useful information to such travellers. To describe such a book would be a tedious task; suffice it to say that the writer touches upon almost every topic that could be wished, and in many instances gives valuable information on points little understood in the East.

The book is very handsomely gotten up and the maps especially are carefully and accurately prepared.

OTHER PUBLICATIONS RECEIVED.

Ninth Annual Report of the Railroad Commissioners of Missouri for 1883. *Chicago Popular Monthly*, August, 1884, $1.50 a year, Chicago Popular Monthly Co. Primiere Application a Paris, En 1883, de L'Assainissement Suivant Le Systéme Waring, par Ernest Pontzen; Prix 2 francs, 50 cents, Paris Librairie Polytechnique, 1884. Economic Tracts No. 13, The Work of a Social Teacher, a memorial of R. L. Dugdale by Edw. M. Shepard, Society for Political Education, N. Y., 1884. Alta della Societa Toscani Scienze Naturali, Vol. 4. Professional Papers of Signal Service, No. 13, Temperature of the Atmosphere and Earth's Surface; prepared under direction of Major-Gen. W. B. Hazen by Prof. William Ferrel; Government Printing Office, 1884. Report of Kansas State Board of Agriculture for month ending June 30, 1884, Wm. Simms, Secretary, Topeka, Kansas, 1884. Illustrations of the Durham System of House-Drainage, Guy H. Elmore and Geo. R. Baucus, Kansas City, Mo. *The Young Meteorolo-*

gist and Antiquarian, Vol. 1, No. 1., T. H. Page, Wheaton, Ill., 75 cents a year. Catalogue of Monticello Ladies Seminary, 1884, Godfrey, Ill.; address Harriet U. Haskell, Principal, or Rev. Truman M. Post, D. D., President, St. Louis, Mo. Changes in the Currents of Ice of the Last Glacial Age in Eastern Minnesota, by Warren Upham. Circulars of Information of the Bureau of Education, No. 3, 1884, articles by Chas. Warren, M. D., and appendix by J. L. M. Curry, LL. D., Washington, D. C., 1884. Johns Hopkins University Studies, second series: Institutional Beginnings in a Western State, by Jassa Macy, A. B., July, 1884. The Minnesota Valley in the Ice Age, by Warren Upham, Salem, Mass., 1884. Circulars of Information of the Bureau of Education, No. 2, 1884, by Julius Ensign Rockwell, Washington, D. C., 1884. *Humboldt Library*, No. 38, double number, 30 cents, Origin of Species by Means of Natural Selection, by Chas. Darwin, M. A., F. R.S., in two parts, Part I, publisher J. Fitzgerald, New York. *American Meteorological Journal*, July, 1884, W. H. Burr & Co., Detroit, Mich., $3.00 per annum.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

CUFF-HOLDER.—This invention consists of a modified form of the common safety-pin, having a special button attached to a flat sided hook playing through the guard-arm and adapted to hold the cuff in proper position upon the wrist, the pin being attached to the inside of a coat-sleeve and the bottom used in supporting the cuff.

A flat-sided guard-hook is constructed to operate loosely in an opening through the guard-arm, and having suitably secured to the end opposite the hook, a button of any approved construction.

In operation the cuff is placed on the wrist, and is held in the desired position by inserting the pin-point through the sleeve or lining of the coat or other garment; the pin-point is next placed within the hook, the spring of the pin acting through the hook and button-standard, presses the button to the cuff and in this manner the cuff is securely held in place.

The button may be permanently secured at a proper distance to the guard-plate or arm, but in that arrangement, however, the cuff would not be held sufficiently secure and would wabble, hence the button standard-hook is but loosely attached, so that the spring will draw the button down on the cuff and hold the latter more securely than in the arrangement with the permanently fixed button.

The pin is not only a pin, but it acts to hold the button securely pressed to

the cuff, the hook and its opening through the plate are constructed with one or more flat sides to prevent the hook from turning, thereby causing the hook of necessity to remain in proper position to receive the pin.

The entire device, including the opening through the guard-arm except the guard-hook and button-standard, may be constructed of a single piece of wire; the hook and button-standard are preferably made of a single piece of wire, so coiled to form an oblong flat surface, and afterwards bent to the shape of a hook. The inventor is Mr. Norman H. McAllister, of Kansas City, Mo.

COMBINATION WRITING INSTRUMENT.—This invention relates to improvements upon that class of convenient pocket instruments in which there is combined a pen or pencil, a self-inking rubber stamp, a rubber eraser and a steel knife eraser, and it consists principally in fixing within the upper end of an ink-pad shell the before-mentioned erasers, and in so constructing the different parts that the instrument will be of a uniform size throughout its entire length.

This desired end is accomplished by stamping the inking-pad and the stamp shells, each into a comparatively semi-circular form, so that when the two are closed together they form a nearly perfect hollow cylinder.

In operation, by pressing upon the side of the ink-pad shell opposite its hinge and upon the eraser end thereof the slight projection upon the upper end of the stamp-shell is sprung from a slight indenture at the base of the erasers, upon the upper end of the before-mentioned ink-pad shell, and by reason of the coiled springs the parts are thrown into a position for using the rubber stamp which is pivoted to the upper end of the main shell.

The end of the pad-spring bears upon the latter surface, and the end rests against the inner surface of the ink-pad. The knife-eraser is provided with a cylindrical head by means of which it is fixed within the upper end of the ink-pad shell, and the rubber eraser is cored out so that it may fit over end protect the knife.

By constructing an instrument in the manner and of the form above described, the manifold utilities thereof will need little explanation: for instance, writing may be executed with the pencil and erased with the rubber; the pen or the stamp may be used and if desired their impressions erased by means of the steel scraper. The inventor is Mr. C. Blitz, of Kansas City, Mo.

AUTOMATIC CAR COUPLING.—The object of this invention is to provide a coupling for railroad rolling-stock that will obviate the necessity of the operator going between the cars; and it consists of a draw-head that is provided with a narrow vertical chamber in which is journaled a semi-rotative disk formed with a segmental coupling-hook that is adapted to be automatically thrown out of balance by the entering link; the heavier weight of the disk upon the side opposite the segmental coupling-hook keeps the said link firmly within the draw-head, and it consists, further, of a bail and cranks attached to the disk-journal, whereby said disk is rotated for the purpose of grasping and releasing the link.

Cords or chains are attached to this bail, so that it may be operated from each side of the car.

A draw-head is provided, in addition to the flared opening for the link, with a vertical circular disk-chamber, open at the bottom and closed at the top. The rotary coupling-disk is provided with the before-mentioned segmental hook, which, when the said disk is rotated by the link striking the inner inclined edge of the annular slot, acts as a coupling-pin, and the said link cannot be withdrawn until the disk is turned in an opposite direction.

The link-opening, at its inner extremity, is in the form of a right-angle or a hypotenuse, and the link, upon entering the opening, is guided by the inclined sides of the angle to the apex thereof, at which point the said link, resting near its center upon the convex lower side of the aforesaid opening, should lie in a parallel position.

Now, by operating the chains, which are attached to the car, the bail, to which such chains or cords are fastened, is raised, and, the same being jointed to the disk-journal by means of the side cranks, the coupling-disk is rotated slightly, and the link may then be withdrawn; but when a link is already within the draw-head, and it is desired to couple with a draw-head that is of a different height, the outside end of the link may be easily raised or lowered by reason of the weighted side of the disk, resting upon its inner extremity in the angle of the link-opening.

By manipulating the weight of the disk in making a coupling, the operator, aided and by reason of the before described inclined surfaces at the end of the link-opening, may hold the link parallel with the draw-bar, or it may be slid forward and downward, or forward and upward, as desired.

Stops upon chains prevent them from being drawn up so high that they cannot be readily reached from the ground. Handholds also are attached to the ends of the chains for convenience.

A stop, upon the end of the car a short distance above the bail, prevents the opening of the coupling until the bail is lifted by means of the chains.

A stop-lug upon the disk prevents the same from rotating so far as to allow the cranks to form a line with the bail-arms. The inventor is Mr. W. H. Holley, of this city.

Balancing Engine Slide-Valves.—A very simple idea, yet an efficient and practical device, has been patented by Mr. James Bewsher, of this city, for overcoming the justly condemned pressure exerted by the steam upon the back of a steam-engine slide-valve.

To the back of the valve in bearings that are cast thereon, is journaled midway of its length, an equalizing-bar, having a short link journaled to each extremity, one of such links extends downwardly to the bottom of the steam-chest where its lower end is securely journaled, the other extends upward and is pivoted to the piston of a small cylinder upon the top of the steam-chest.

When the steam is pressing downwardly upon the valve, it at the same time

presses the piston of the balancing-cylinder upward, and as each presents very near the same surface to the pressure, it follows that the valve will be balanced and can be reciprocated by an extremely small power.

The outer ends of the connecting links before mentioned, remain stationary, but as their inner extremities are connected to the equalizing-bar, they, of course, are caused to oscillate in a vertical line, and as each has a similar radius, the balancing piston is devoid of motion.

VIRGILIAN PROVERBS.

F. J. MILLER.

It seems natural to man to delight in axioms, those formulæ of thought which bear the stamp of truth upon the surface, and which no one can call in question. And perhaps it is this natural delight which leads us to crystallize into proverbs those other principles which, though not axiomatic, are still so broadly founded in reason and experience as to be generally admitted to be true.

The pleasure we experience in meeting these proverbs, however disguised they may be in poetical garments, is that of being on familiar ground. We, too, have experienced or observed the same thing, and this common thought at once brings us into intimate relations with our author; we can strike hands with him and say, "Yes; I know that." The author who utters for men their own thoughts is the most appreciated, the most popular, the most quoted. The popularity of Virgil may be explained, at least in part, on these grounds. The ardent student often finds with delight that the author for a moment leaves that which is new and strange and greets him in his own tongue. We cull a few examples out of the riches before us, choosing almost at random. Our poet sings:

"Quid non mortalia pectora cogis, auri sacra fames?"

and again,—

"Improbe amor, quid non mortalia pectora cogis?"

and our observation daily tells us that the same "fatal thirst for gold," and the same "base passion" drive men to all extremities to-day.

The stately utterance of the Trojan hero,—

"Dolus an virtus, quis in hoste requirat?"

has retained its substance, though changed in form, in the English proverb,—

"All's fair in love and war;"

and we recognize the "courage of despair" in

"Una salus victis, nullam sperare salutem."

Our English proverbs are often open to the criticism of inelegance and slang. Not so the Virgilian. While the elegant Mantuan comforts the love-lorn swain in this fashion, "Invenies alium, si te hic fastidit, Alexim,"—his English cousin, with more force than elegance, will only say: "There are as good fish in the sea as ever yet were caught."

How vividly reproduced are such expressions as "David in Saul's armor," "sailing under false colors," "wearing borrowed plumes;" and that other proverb which, though rude, is still at the foundation of all success,—"Let every tub stand on its own bottom,"—how bitterly the meaning of them all is realized in the cry of the luckless Trojans,—

"Heu nihil invitis fas quemquam fidere divis!"

Against the "Judas kiss" and the "wolf in sheep's clothing" comes the warning cry of Laocoön,—

"Timeo Danaos et dona ferentes."

Those were genuine men, and not Trojans merely, in that old ship race off the coast of Sicily, for then

"Hos successus alit, possunt, quia posse videntur;"

and just as truly to-day, "Nothing is more successful than *success.*" Thus we may see in Virgil's pages the true spirit of stoic indifference,—

"Quid quid erit, superanda omnis futura ferendo est;"

and the "ruling passion,"—

"Trahit sua quemque voluptas;"

and the lightning-like speed of rumor,—

"Fama, malum qua non aliud velcuis illum."

These comprise only a few of many similar passages. By means of these, and topics of like nature, an excellent review of Virgil may be made. Thus, if the student be directed to pick out all the proverbs, the similes, the flowers, the Roman customs, or the different uses of any word, he will undertake his work with all the ardor of an explorer, and, without knowing it, will obtain such a knowledge of the author as he could get in no other way.—*Journal of Education.*

THE THREE GENERA OF THE GREEKS.

F. A. JONES.

The Diatonic Genus among the Greeks was divided into several modes, or which, in our modern terminology, are denominated scales. They comprised the following: the Dorian, the Phrygian, the Lydian and the Mixo-Lydian; the first of these commencing on D, the second on E, the third on sharp F and the fourth on G, and each of these modes had a corresponding or collateral mode, distinguished by the prefix Hypo, signifying under, as Hypo-Dorian, Hypo-Phrygian, Hypo-Lydian and the Hypo-Mixo-Lydian. These Hypo modes were situated at a 5th above or its inversion a 4th below the original four modes which were termed authentic in contradistinction to the Hypo modes which were termed Plagal from *plagios* signifying sideways or athwart; thus for example, the Hypo-Dorian may be reckoned from A, consisting of natural notes, the Hypo-Phrygian from B including C sharp and F sharp, the Hypo-Lydian from C sharp including D sharp, F sharp and G sharp, and the Hypo-Mixo-Lydian from D containing B flat. The first of these genera is known as the Diatonic genus; this

admits of the normal notes of the key in which a musical passage is cast, that is to say notes that accord with the signature of each key in modern music.

Through inflection or change by sharps or flats, notes bear the same relationship to their key-note. Thus, for example, the sharps which characterize the key of E or the flats that distinguish the key of E flat cause the notes of these keys to be brought into the same relationship with their key-note as do the natural notes to the key of C. Sharps or flats then, may exist in the Diatonic genus, but those only which belong to the signature of the key. In order to elucidate my subject more clearly, I may here endeavor to explain the term Diatonic, which is derived from two Greek words, *dia* signifying through, and *tonos* a tone or a sound, therefore this compound word signifies, literally, through the tones or sounds, and a Diatonic scale may be defined as a series of eight notes, which proceed alphabetically from any note to its octave, by five tones and two semi-tones, this scale is divisible into two sections known as Tetrachords; this again has a Greek origin *tétra* signifying four, and *chordé* a string, and if we take the natural scale of C we find it to be constituted of two perfect fourths, C to F, forming the first tetrachord, and G to C the second, which, taken together form the Diatonic scale. Two scales which have a tetrachord in common are termed relative scales. Every tetrachord belongs to two major scales, every major scale having one tetrachord in common with the scale which precedes it in the series of scales, and another tetrachord in common in that which succeeds it.

The ancient, strict, or contrapuntal style of harmony may be termed, or designated Diatonic, because in it no notes are employed which do not belong to the diatonic scale of the key major or minor, which may for the time prevail. This admits of diatonic notes only, subjects every note of the scale to the same laws, allows the 4th to the bass to be employed in no way but as a discord, admits of no unprepared discords except passing notes, and allows not passing notes to be approached by leap. Diatonic therefore consists of notes according to the signature of the key. The leading-note of the minor key, though indicated by an accidental sharp or natural, is diatonic, so also are the major 6th and minor 7th of the arbitrary minor scale.

When modulation occurs, the accidentals that denote the change of key are to be regarded as belonging to the signature of the new key, and thus are diatonic in the key to which the modulation is made. For example, a passage commences in the key of C and we wish to modulate into the key of G; the F sharp which induces such modulation is to be regarded as belonging to the signature of the new key, and thus is diatonic in the key of G. The modern, free or chromatic style of harmony admits of chromatic as well as diatonic notes; admits of exceptional treatment of certain notes, allows the fourth to the base to be employed as a concord, admits of fundamental discords, and allows passing notes to be approached by leap. It may also be well in this place to give a brief definition of fundamental discords. They are formed of the notes generated according to the natural system of harmonics; they are all derived from the dominant, the supertonic, and the tonic. Those belonging to the last two roots are all chro-

matic; those belonging to the first root are some chromatic and some diatonic; they require no preparation and have various resolutions. The word chromatic is of Greek origin, it signifies colored; a note or a chord either belongs to the key of the passage that precedes it or to the key of the passage that succeeds it; if that which preceeds it and that which succeeds it be both in the same key, this note, or chord, though foreign to the signature, induces no modulation, and is therefore chromatic. The phenomenon that every musical sound generates others, is the basis of the free or chromatic style of harmony. This phenomenon is demonstrable on every string, and every pipe of length sufficient and consequent depth of tone, for the ear to detect the more and more delicate sound of its generated notes, or harmonics as they are technically called, when they successively become evident to the perception. All wind instruments yield their harmonics, not together indeed, but successively to the stronger pressure of the player's breath, and those of the class of horns and trumpets have no other notes than their harmonic sounds, and the performer has no means of varying these but by the different manner in which he may direct his breath through the pipe.

Instruments of the violin class have also their harmonics which are produced by a mechanism totally different from that for intonating the consecutive notes of a scale. A cathedral, being a hollow form, is an enormous pipe, and this property which it possesses in common with the smallest wind instruments of giving out harmonic or generated sounds, must be the reason why early musicians, as a rule made their final closes upon a major chord, though the key of their piece were minor; since the major third is one of the most prominent notes of the harmonic series, so prominent indeed in buildings of great reverberation as to jar against the minor third if this be long sustained. We have but to extend further the inferential idea of smaller or larger vibrating media, and to follow this in thought into infinity, and we may willingly acknowledge the unmeasured concave of nature to be an immense musical instrument; when the Pythagorean doctrine of the music of the spheres will cease to seem a figurative image, a scientific myth, and will appear to ordinary comprehension but the statement of a fact, whose manifest evidence is within the reach of our senses. The whole system of chromatic or generated harmony is based on the following well established principles, viz: that the sounds of nearly every musical instrument with which we are acquainted are not, as they are ordinarily taken to be, single tones of one determinate pitch, but compound sounds containing an assemblage of such tones.

These are always members of a regular series, forming fixed intervals with each other; for instance, if we take C an octave below tenor C as a generator, the first overtone or harmonic audible is its octave, then the fifth above that octave, then the second octave or fifteenth above the generator, then the major third or two octaves and a major third above the fundamental sound, etc. This may be illustrated as follows: If a stretched string fastened at both ends, be caused to vibrate, communicating its vibrations to the air, the whole length of the string vibrates alone only momentarily; its divisions also vibrate, which produce cer-

tain sounds in rapid succession, superposed upon the principal sound, which sounds are called its harmonics or overtones, the sound produced by the vibration of the whole string being termed the generator. For example the vibration of the whole length of the string is followed by that of half its length which produces the 8th to the fundamental sound, then by one-third of its length, which produces the 5th, then by the one-fourth of its length, which produces the double 8th or 15th, then by one-fifth, producing the major 3d to that double 8th, etc., and by proceeding in this manner we learn that the major 3d and the minor 7th belong to the series of harmonics, and are thus naturally prepared whenever their generator is sounded; our singing or playing this combination of notes is then but a stronger articulation of sounds that are already vibrating in the air. The vibration-numbers of these overtones are connected by a simple law, which is readily deduced from the above relation.

Suppose the generating note to make 100 vibrations per second, two will make twice as many i. e. 200; (3) being a fifth above (2) will $=\frac{3}{2}\times200=300$ vibrations; (4) being a fourth above (3) will produce $\frac{4}{3}\times300=400$ for (5) $\frac{5}{4}\times400=500$, for (6) $\frac{6}{5}\times500=600$. The numbers therefore come out 100, 200, 300, 400, 500, 600. A sound may not contain all the overtone series, but never can a tone intermediate in pitch between any two consecutive members of the series make its appearance. Further evidence in support of this most important proposition may be enunciated, and in order to do this, the piano forte may be taken as one example. Let tenor C be first silently pressed down, and then C an octave below vigorously struck, and after a few seconds be allowed to rise again. The lower note is at once extinguished, and we now hear its octave sounding from the wires of tenor C, but if the damper fall back on these, by releasing the note hitherto held down, the whole sound is at once cut off. Next, by freeing the damper from the wire of the 12th or 5th above tenor C and pursuing a similar course a like result may be obtained, and so on for the 15th and the major and minor 3ds, but they fall off rapidly in intensity, and by this important fact we learn that the vibrations of any instrument are excited by resonance only when vibrations of the same period are already present in the surrounding air, and as the only sound directly originated in each variation of experiment was C and octave below tenor C this note must have contained the notes successively heard. The enharmonic is the third genus of which I have to treat, which with the Greeks comprised an interval less than the semi-tone, that is to say a note between E and F, higher in pitch than E, but not so high as F, and on keyed instruments it signifies the distinction between two notes of the same sound but having different names, as A flat and G sharp. The Persians for instance, divide their scale of an octave into eighteen sounds and the eastern and southern nations habitually intonate smaller intervals than semi-tones: whereas our modern scale is divisible into only twelve. Again in theory raising a note to its sharp means multiplying the number of vibrations per second of that note by the ratio $\frac{25}{24}$, which is the ratio of the number of vibrations per second of two notes at an interval of a minor semi-tone. To lower it to its flat on the other hand, means to multiply

the number of vibrations per second by the inverse ratio $\frac{24}{25}$. By example on the piano-forte it is necessary to add to the seven white keys of an octave seven black keys and not give as is done in practice: as raising to a sharp means rising through the interval $\frac{25}{24}$, and this interval does not exist in the simple musical scale. For illustration, between E and F there is an interval of a major semitone $\frac{16}{15}$. If E then be raised to its sharp a note is found, by rising through the smaller interval $\frac{25}{24}$, which is near F but lower; E sharp then does not coincide with F.

The foregoing remarks, which contain the truth, and nothing but the truth, though not the whole on the boundless subject here in part advanced, are based upon the teachings of some of our most eminent theorists of modern times, among whom I may mention the distinguished Professor of Music in the University of Cambridge, Sir George Arthur Macfarren, Mus. Doc. M. A., Principal of the Royal Academy of Music, and Sedley Taylor, Esq., M. A., Trinity College, Cambridge.

KANSAS CITY, MO., May, 1884.

DEATH OF BLACK-BIRD, THE OMAHA CHIEF.

OSCAR W. COLLETT, CUSTODIAN MUSEUM MO. HIST. SOCIETY.

The sixteenth annual report of the Peabody Museum contains a letter to which Prof. Putnam calls attention as of especial interest, written by Mr. Frank La Flesche, an educated Omaha Indian, relating to the history of his tribe, in which certain statements are made that seem to be inaccurate. According to Mr. La Flesche: "It is said that Black-Bird was buried with but very little ceremony, as he died when the Omahas were being very much troubled with the small-pox, and was *not* buried riding a live horse, as is stated by some. A grandson of his is still living, and is about a hundred years old; he cannot remember when his grandfather died, but thinks it was shortly before he was born." Mr. La Flesche then proceeds to assume, hypothetically, on the testimony of the grandchild and tribal traditions, that Black-Bird died more than a hundred years ago; and as the migrations of the Omahas northwardly "from near St. Louis" took place according to the same traditions, a century earlier, we are thus enabled to determine that these movements began a little previous to 1684.

An English naturalist who spent some time in the west during the first decade of the present century, in his journal of travel, gives the following account of Black-Bird:

"This chief, called by the French *Viseau Noir* (Black-Bird), ruled over the Mahas with a sway the most despotic. He had managed in such a manner as to inspire them with the belief that he was possessed of supernatural powers; in council no chief durst oppose him—in war it was death to disobey. It is related of him at St. Louis, that a trader from that town arrived at the Mahas with an

assortment of Indian goods; he applied to Black-Bird for liberty to trade, who ordered that he should first bring all his goods in his lodge, which order was obeyed. Black-Bird commanded that all the packages should be opened in his presence, and from them he selected what goods he thought proper, amounting to nearly the fourth part of the whole; he caused them to be placed in a part of the lodge distinct from the rest, and addressed the trader to this effect: 'Now, my son, the goods which I have chosen are mine, and those in your possession are your own. Don't cry, my son, my people shall trade with you for your goods *at your own price.*' He then spoke to his herald, who ascended to the top of the lodge, and commanded in the name of the chief, that the Mahas should bring all their beaver, bear, otter, muskrat, and other skins to his lodge, and on no account to dispute the terms of exchange with the trader, who declared, on his return to St. Louis, that it was the most profitable voyage he had ever made. Mr. Tellier, a gentleman of respectability, who resided near St. Louis, and who had formerly been Indian agent there, informed me that Black-Bird obtained his influence over his nation by means of arsenic, a quantity of that article having been sold to him by a trader, who instructed him in the use of it. If afterward any of his nation dared to oppose him in his arbitrary measures, he *prophesied* their death within a certain period, and took good care that his predictions should be verified. He died about the time that Louisiana was added to the United States; having previously made choice of a cave for his sepulchre, on the top of a hill near the Missouri, about eighteen miles below the Maha village. By his order his body was placed on the back of his favorite horse, which was driven into the cave, the mouth of which was then closed up with stones. A large heap was afterwards raised on the summit of the hill."

In another place is the following entry: "In the forenoon of this day (A. D. 1809,) Mr. Hunt was waited upon by two chiefs, who were contending for the sanction of the Government of the United States, to determine their claim to kingly power. Mr. Hunt declined interfering, not being vested with the power to act. The names of these two chiefs were Big Elk and White Cow, the former of whom ultimately succeeded."

At that time the range of the hunting grounds of the Mahas was from their village to *l'Eau qui Court,* and along that river.

Bradbury was a scientific botanist, made a voyage up the Missouri with Hunt and Liza in 1809, visited the Omaha village, and on his return spent the winter of 1809–10 in St. Louis. The occurrences of which he speaks were then so very recent as to be quite fresh in memory, and of public notoriety, and some persons at least, it may be assumed, had personal knowledge of the facts they imparted to the English naturalist; for this reason I am inclined to receive his account of Black-Bird's death and burial as trustworthy, and especially the approximate date given. Of course, if the topographical conformation of the bluff at the entrance to the cave is such that a horse could be led into the cavern, the chief was probably not entombed riding on his steed; but if the lay of the

land present no special obstacle, it appears to me the narrative as a whole should not be rejected.

But I think the date of Black-Bird's death can be determined pretty accurately. It is quite certain that Black-Bird was the great Maha chief with whom Clamorgan's fur company traded, and to whom Baron Carondelet, governor of Louisiana, sent medals and presents. But all this occurred during the year 1794 to 1796. According to Omaha tradition, as reported by Mr. La Flesche, the chief died during the year the tribe were so "much troubled with the small pox." But August Chouteau testifies that the small-pox made its first appearance in upper Louisiana, in the spring of 1801. This date is generally received as correct. The next year it began to spread among the Indians. The same naturalist, already quoted, writes: "In 1801, the Mahas were visited by the small-pox, which made dreadful havoc, and destroyed at least two-thirds of the whole nation." I find in all this sufficient proof to satisfy my mind that Black-Bird died in the year 1802.

As to the date when the Omahas began their migrations northwardly "from near St. Louis, assuming that they ever were there, I have no information. But it would seem that it may have been earlier than Mr. La Flesche supposes, as (whatever the testimony is worth,) I find on Marquette's Map 1673, (Shea's *fac simile*,) the "Maha" located in the interior on a line north of the mouth of the DesMoines River.

ST. LOUIS, MO., 1884.

DIRECTIONS FOR COLLECTING VERTEBRATE FOSSILS.

CHAS. H. STERNBERG.

The proper outfit for a collecting expedition consists of a good team of ponies or small mules, a light lumber wagon, cover, wall-tent, camp-stove or "Dutch oven," knives and forks, tin plates and cups, and other cooking-utensils. Each member of the party should be provided with a rubber blanket and coat, and a couple of pairs of woolen blankets; besides these but little extra baggage should be taken; a good pair of woolen shirts are valuable. The tools should consist of several small hand-picks, miner's picks, with one point made into a duck-bill with sharp edge; butcher-knives, shovels and collecting-bags—made after the pattern of mail-carrier's bags, of heavy ducking with two apartments—one for cotton, paper and string, and the other for fossils. There should always be kept on hand a supply of burlap sacks, old newspapers, cotton, manilla paper and hop-needles; boxes and barrels for shipping.

A good saddle-pony is a valuable addition, as one can ride on ahead and choose a good camp or discover localities. When a camping-ground is chosen (which should of course, when possible, have wood, water and grass near at hand,) the first thing to be done is to pitch the tent, this is done by stretching it

out on the ground and staking down one side, the front flaps are then brought together and a stake driven in them, the other side and back are pinned down when the ridge-pole and uprights are put in, and the tent raised. Then the stakes for the walls are driven and the tent stretched by means of guy-ropes, when all is ready for the reception of the baggage. On making a bed a rubber blanket is first laid on the ground—rubber down—one pair of blankets are doubled length-ways and laid down and the other pair is used to cover the occupant. I find it valuable to have a narrow mattress of "excelsior," as it makes a most comfortable bed and adds but little to the weight on the road; mattress and blankets are rolled up and securely strapped.

On going into the field the collector takes a pick, butcher-knife and collecting-bag, with plenty of paper, string and cotton. When a specimen is discovered the first thing to be done is to collect all the fragments and dig up the debris for others which should all be carefully preserved. The rock above the specimen is then removed to within a short distance of the bones, and they are traced out by means of a butcher-knife. The bones should never be fully exposed, as the field is not the place to study anatomy. The idea of exposing a small portion of the bones is to show one where he can cut out his slabs. This is done by digging a trench the width of the pick three or four inches in depth, the slab is then loosened by striking carefully all around the specimen.

In packing, cover the exposed bones with cotton, the slab with dry grass and bind strongly with twine. Cover with burlap and sew securely. For packing in boxes put in plenty of dry grass in the bottom and put in the slabs on edge, tamp down grass between them and the edges of the box with a mallet and wooden spatula, have plenty of grass next the cover and bind the box with strap-iron.

When the bones are in loose sand great care should be exercised in laying bare the bones, not to remove any until all the limbs are uncovered, then make a sketch on strong paper, marking each bone and the corresponding one on the sketch. If the bones are broken in places mark a cross with colored crayon and make a sketch showing the breaks numbering all the sections which should be taken out separately and wrapped, the wrapper bearing a corresponding number.

Never attempt to take out a wet or damp specimen, as it will surely fall to pieces. All specimens should be allowed to lay exposed to the sun and wind as long as possible. Pack each limb (properly marked to correspond with sketch,) by itself. The skull should be wrapped in cotton and strong paper, and then carefully bound with strong twine. A burlap sack is then ripped open and plenty of dry grass laid over it, the skull is put in and the ends brought together and carefully sewed. The greatest care should be used in marking, each specimen should bear a tag with number, date, locality, formation and collection, and if it is necessary to use more than one sack have a similar label on each, be sure to wrap all fragments broken off with the bone to which they belong.

Fishes are among the most difficult specimens to preserve, the bones are very frail and splinter so badly that it is almost impossible to restore them. Where the upper surface is laid bare the bones should be carefully brushed off,

and one layer after another of strong paper pasted on until the necessary strength is given, then if the bones are loose turn them over and repeat the process—make a mucilage of gum Tragacanth.

Another good way, is to cover the specimen with two or three inches of plaster of Paris and allow it to set, this gives a fine protection to delicate bones. Never be in a hurry in collecting or searching for fossils. Go over the ground several times and remember that the less the specimen is exposed the more valuable will it be. In the Niobrara beds in summer go into the beds early and work until ten o'clock, and in the afternoon leave camp at half past two and work as long as you can see. You will find a pair of smoked glasses of value in collecting in hot weather.

In packing the specimens into boxes use great care. Never pack heavy and light specimens together. Mark each box with marking ink and number each. Under the cover put a card with description of contents, date, formation and collector. Always keep a note-book and record each day's work with description of specimens collected and notes on the stratigraphy of each formation with as many sections as possible.

The mode of mending specimens to prepare them for study is as follows: The matrix is first carefully removed, and the edges to be joined made perfectly clean. A cement made of glue, to which, when dissolved, plaster of Paris is added until it is of the consistency of thick cream is at hand, and when the pieces to be united are ready their edges are given a thin coat of cement with a brush, they are then pressed closely together and held a short time until the cement is hard when another piece is added, and so on until the bone is mended. Each specimen is labelled and a record kept.

THE CAUSE OF CHOLERA.

The London *Lancet* remarks that the epidemic of cholera in the south of France does more than maintain itself; it increases and it has diffused itself over a somewhat larger area. But for all that it is still a limited outbreak, and the hope that it may in the main be confined to the neighborhoods first attacked may perhaps be realized to a greater extent than was at first thought possible. So far, the rumors as to its extension to Paris and towns in other countries do not seem trustworthy, and hitherto no case has been brought into the United Kingdom. The *Lancet* gives a summary of a paper on cholera read on the 30th ult. before the Accademia Petraca of Arezzo, by Dr. Tommasi-Crudeli, whose researches on the bacillus malaria from a distinct advance in the etiology of intermittent fever. After tracing the history of the three great cholera epidemics that have visited Europe, he remarked that the disease was always an importation, never acclimatized like small-pox, and he defined it as a "contagio-miasma, a morbigenous germ, proceeding from a diseased human body, which never diffuses itself epidemically, except when the excretions containing it find in the soil conditions

favorable to the multiplication." Fillippo Pacini, of Florence, who died just a year ago, was, in 1854, the first to recognize the cause of cholera in a microscopic organism. This organism, according to Pacini, attacked the mucous membrane of the intestine; but his doctrine was ridiculed or disregarded till the other day, when the German Commission investigating the specific cause of cholera in Egypt and its native seat, the delta of the Ganges, came to the conclusion already arrived at by the Tuscan pathologist.

The cholera germ imported by patients, or their infected clothes, becomes epidemic only in countries presenting conditions favorable to its development. This development does not happen everywhere in the same mode, and in certain places it does not happen at all. When the disease has entered a country we cannot say whether it will take firm hold or not. We only know that its spread may be favored by four conditions: 1. Porosity of the soil in which choleraic dejections have been allowed to penetrate. 2. Oscillations of the underground waters by which the cholera miasm which has developed in the soil may reach the respirable atmosphere. 3. The accumulation of fæcal matters or of organic detritus infected by the germ. 4. The facilities offered to the diffusion of the germs in the drains, in the soil, in the air of the locality and in the drinking-water. Dr. Tommasi-Crudeli does not believe in sanitary cordons. They are as little able to keep cholera out of a province as custom houses are to prevent smuggling. Quarantine afloat he has more belief in, if properly carried out, without regard to the incubation period of cholera (eight days). But the sheet anchor of the prevention of cholera is the exclusion from the dwelling house and its inmates of the cholera germ. His counsels in this regard are similar to those of the English sanitary authorities—if possible a little more stringent as to the washing with disinfectants of all linen, whether visibly fouled or not with fæcal matter. As to prescribing a diet different from what suits the individual in ordinary health, he ridicules the notion.

EDITORIAL NOTES.

THE 33d meeting of the American Association for the Advancement of Science, will be held at Philadelphia, September 4th to 10th. It is held at a later date than usual for the purpose of giving the members an opportunity to exchange courtesies with the British Association which meets in Montreal August 27th. At the same time the International Electrical Exhibition will be in session at Philadelphia, also the American Institute of Mining Engineers and the Pennsylvania Agricultural Society. It is probable that while the members of the British and American Associations are enjoying each others' society at Philadelphia, steps will be taken towards organizing an International Scientific Association. This will doubtless be the most largely attended meeting of the association, and extensive arrangements are being made to accommodate and interest all visitors. All communications concerning rooms and other local matters should be addressed to Prof. H. Carvill Lewis or Dr. Edward J. Nolan,

Secretaries of the Local Board at Philadelphia. All official enquiries to Prof. F. W. Putnam, who will be at Salem, Mass., until August 20th, after that date at Hotel La-Fayette, Phildelphia.

THE Brighton Electrical Railway, a suburban road at Brighton, England, about one mile long, appears to be a success. Its average earnings are stated to be over £34 per week and its expenses and interest only £18, leaving a net profit of £16 per week. It has at present only one car, which runs about eighty-two miles per day, seats thirty passengers, and makes a speed of eight miles per hour.

CHICAGO parties are said to have purchased land in Iron and Reynolds Counties, this State, and a stock company with a capital of $250,000 has been organized for iron and silver mining. They have already purchased over 1,000 acres of land, and have contracts for nearly 3,000 more. An expert mining engineer from Pennsylvania has been employed and will have charge of the development of the property. Another company with a capital of $50,000 is being organized to quarry marble and granite on the Black River.

DR. CARLOS FAREMBA, of Mexico, has addressed a circular letter to all representatives of foreign governments now in Washington, advocating the celebration of the discovery of America on its 400th anniversary, October 12, 1892, and the erection of a monument on the spot where the first landing was made.

DR. JOSEPH HALL, President of the New Orleans Board of Health, states that, after the most fair and unlimited trial, carbolic acid has proved a failure as a general disinfectant, and especially in yellow-fever. In its place he has adopted bi-chloride of mercury, which costs only about 80 per cent as much, and is in his opinion the most powerful germicide known, and at the same time it is free of all unpleasant smell and color. The standard solution will be six ounces of the mercury and four ounces of muriate of ammonia first dissolved in a half gallon of water and then added to forty gallons of water.

THE State Natural Historical Society of Illinois held its annual meeting at Peoria, July 7 and 8, 1884. An address was delivered by the President Dr. Julius S. Taylor, of Kankakee. Papers were read by Hon. Wm. McAdams, Prof. S. A. Forbes, A. B. Seymour, A. H. Mundt, and others. An excursion was also taken up the Illinois River for field work and a pic-nic, which was much enjoyed by all. An election of officers was held just before returning, at which the Hon. Wm. McAdams, of Alton, was made President for the ensuing year, and S. A. Forbes, Secretary; Prof. Burrill and Mr. J. E. Armstrong were made Vice Presidents. Tylor McWhorter was elected Treasurer and Dr. Edwin Evans and Mr. A. H. Mundt were chosen as additional members of the Executive Committee.

AT Cleveland, Ohio, Mr. Walter Knight has succeeded in perfecting a plan for running street cars by electricity. Last week a mile of track was prepared for it and forty persons were carried for as many trips over the road at a rate of speed ranging from one to fifteen miles an hour, at the will of Knight, the inventor. The plan being considerably cheaper in its working than the old way and as any number of cars can be placed on the circuit to run independent, the East Cleveland line will adopt it and will immediately make the necessary arrangement.

IT is proposed to organize, under the auspices of the American Social Science Association, during its next annual session at Saratoga, September 8–22, 1884, an American Historical Association, consisting of professors, teachers, specialists, and others interested in the advancement of history in this country. Friends of history can profit by association with one another and also

with specialists in the kindred subjects of Social Science, Jurisprudence, and Political Fconomy, which are represented at this annual meeting in Saratoga. By conference with co-workers historical students may widen their horizen of interest and cause their individual fields of labor to become more fruitful. The leading spirits in this movement are Prof. Jno. Eaton, Prof. F. B. Sanborn, Prof. C. K. Adams, Prof. M. C. Tyler and Prof. H. B. Adams.

THE American Wood Preserving Company have been awarded the city contract for paving Chestnut Street, St. Louis, from Jefferson to Grand Avenue with gum lumber treated by the zinc-gypsum process.

DR. LEWIS SWIFT, director of the Warner observatory, has received intelligence of the discovery of a comet by Prof. E. E. Barnard, of Nashville, on the night of the 19th instant, and the discovery was verified by the motion of the comet the next night. It is in the head of the Wolf, right ascension 15h., 50 m., and 30s., declination south 17° 10′, and is moving slowly in an easterly direction. It seems to be growing brighter, and is probably coming toward the earth. This is the first comet discovered in the northern hemisphere this year.

ITEMS FROM PERIODICALS.

THE August *Harper's* is especially noteworthy for its papers on American places—"The Gateway of Boston," in which W. H. Rideing describes and Messrs. Halsall and Garrett picture Boston Harbor; Salt Lake City, described by Ernest Ingersoll, with fifteen illustrations; and Richfield Springs, a paper with special reference to their medicinal waters, by F. J. Nott, M. D. Mr. Boughton will continue his chatty "Artist Strolls in Holland" in company with Mr. Abbey. Art will be represented by a paper on the work of the "Associated Artists" by Mrs. Harrison, with charming illustrations of the needlework designs of Mrs. Wheeler, Miss Dora Wheeler, and others, as well as by the frontispiece reproduction of Mr. Dewing's rose-painting, "A Prelude;" sport, by "Antelope Hunting in Montana," with illustrations by Beard and Frost; history, by the first of a series of brilliantly written and illustrated papers on "The Great Hall of William Rufus," by Treadwell Walden. William Black's and E. P. Roe's novels will have their usual superb illustrations by Abbey, Gibson, and Dielman, and more of the charming landscape illustrations by Alfred Parsons will accompany a further installment of Mr. Sharp's poem-pictures, "Transcripts from Nature." There will also be stories and poems by Mrs. Macquoid, Mr. Bynner, Lucy Larcom, Mrs. Fields, and others. A paper on "The Building of the Muscle" will be contributed by Julian Hawthorne. Among Mr. Curtis's topics in the "Easy Chair" are National Conventions and College Commencements.

THE *Magazine of American History* for August comes laden with a variety of agreeable surprises. It will attract many readers. The opening article, "The Story of a Monument," by S. N. D. North, of the *Utica Herald*, is a timely production, and of curious interest to the public in general. The illustrations add greatly to its value, of which is the fine portrait of Ex-Governor Horatio Seymour—frontispiece to the magazine. The next article introduces a learned discussion of the new and novel question, "Did the Romans colonize America?" The author, M. V. Moore, foreshadows futher papers, and from the masterly skill with which he handles the subject they will naturally excite wide attention.

THE *North American Review* for August contains an article by Justice James V. Campbell on "The Encroachments of Capital," which will command the serious attention of all readers. Richard A. Proctor treats of "The Origin of Comets," and succeeds in presenting that difficult subject in a light so clear that persons who have little or no acquaintance with astronomy can follow his argument. "Are we a Nation of Rascals?" is the startling title of an article by John F. Hume, who shows that states, counties and municipalities in the United States have already formally repudiated, or defaulted in the payment of interest on an amount of bonds and other obligations equal to the sum of the national debt. Judge Edward C. Loring finds a "Drift toward Centralization" in the recent judgment of the United States Supreme Court on the power of the Federal Government to issue paper money, and in the opinion of the minority of the same court rendered in the suit for the Arlington property. Julian Hawthorne writes of "The American Element in Fiction," and there is a symposium on "Prohibition and Persuasion," by Neal Dow and Dr. Dio Lewis.

THE *Atlantic Monthly* for August has the following attractive table of contents. In War Time, XV., XVI., S. Weir Mitchell; Carpe Diem, E. R. Sill; The Twilight of Greek and Roman Sculpture, William Shields Liscomb; The Zig Zag Telegraph, Lloyd G. Thompson; The Rose and the Oriole, Thomas William Parsons; A Cook's Tourist in Spain, II; Dinky, Mary Beale Brainerd; Nathaniel Parker Willis, Edward F. Hayward; The Edda Among the Algonquin Indians, Charles G. Leland; The Thunder-Cloud, James T. McKay; Bugs and Beasts before the Law, E. P. Evans; An Old New England Divine, Kate Gannett Wells; The Anatomizing of William Shakespeare, III. Richard and Grant White; Where It Listeth, Edith M. Thomas; Lodge's Historical Studies; A Modern Prophet; The Contributors' Club; Books of the Month.

THE *Popular Science Monthly* for August is promptly on hand. The contents are as follows: Hickory-Nuts and Butter-Nuts, by Grant Allen; The Ghost of Religion, by Frederic Harrison; Retrogressive Religion, by Herbert Spencer; Some Rambles of a Naturalist, by Charles C. Abbott, M. D.; Scientific Philanthropy, by Lee J. Vance, B. S.; The World's Geyser Regions, by A. C. Peale, M. D.; (Illustrated.) Reparation to Innocent Convicts, by Dr. Henrich Jaques; The Chemistry of Cookery, by W. Mattieu Williams; My Monkeys, by M. J. Fisher; The Salt-Deposits of Western New York, by Frederic G. Mather; The Morality of Happiness, by Thomas Foster; The Mystic Properties of Numbers, by Etienne de la Roche; Sketch of Professor Felipe Poey, by Professor David S. Jordan; (With Portrait.) Editor's Table; Science and the Temperance Reform; Literary Notes; Popular Miscellany; Notes.

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PHYSICS.

'HE FORCES OF INORGANIC NATURE—SOME NEW PHILOSOPHY.

REV. JAMES W. HANNA.

Some years ago the writer left college armed with a bundle of diplomas, leased especially with what he knew of science. With Espy's theory of meteor-logy in his cranium, he began making observations for himself. The result was iat he soon discarded most that passed for science in meteorology. He con-luded also that the causes of heat and cold were but partly understood. Frosts June and thaws in January were caused by something that our philosophy new little of. Indian Summer next became a study,—then the nature of heat, nd the forces of organic and inorganic nature. The method was to study well e books, but to get behind the books, and ask Nature if certain things were so. n assortment was made of things established, and of things assumed; plausible eories were scrutinized, and the iconoclastic spirit was allowed full play. he result was I became a scientific doubter. Or, rather, a doubter of much of e theories of the scientists. I will not shock the reader by a full disclosure re. And in this article I will as much as possible avoid antagonizing him. y debate against old theories, which would make quite a chapter, may lie with e rubbish. This article is devoted to bringing in some of the new.

The first great point reached, and which after careful study, was fixed and be-me a rallying point was this: *All the attractive forces of inorganic nature are one.* at is to say, gravitation, cohesion, adhesion, capillary attraction, chemical affinity,

electrical attraction, magnetic attraction, contraction of solids, liquids and gases, all these are simply manifestations of the same force under different conditions. These are names by which we designate phenomena, or the causes of phenomena, the names of forces, as force manifests itself in its tendency to bring things together, and hold them together. We have not space here for the argument by which the above conclusion is reached. The realm of physics abounds with data which, when properly considered, make the conclusion irresistible. It is all clear sailing with not a breaker in the pathway. Accepting the above as established, the question arises: What causes this force? What is its origin?

As we wait to learn, we reach another conclusion. There is in nature another force, *repulsion*. A force equal in operation, equal in importance with attraction. It is as everywhere present, it operates in as many varied conditions, it is scarcely less powerful. These two forces are correlated. They pertain to opposite conditions; what gives strength to the one, gives apparent weakness to the other. They never destroy but in all cases they act against each other. Repulsion is seen in the expansion of gases, in the expansion of metals, in electrical repulsion, in the repellent power of heat in all its manifestations. In the Sun there is a repellent power co-ordinate with the attractive power. This drives volatile matter from the comets, thus making their tails; this causes the diurnal revolution of the planets. This gives to the several planets their several distances from the Sun. Thus all along the line, from the highest manifestation in the heavens to the minutest exhibitions of earth, we have these two forces side by side; the one as much a factor in the world of phenomena as the other. Accepting this also as established, the question arises: What causes this force? What is its origin?

As heat expands gases and metals, as it makes solids liquid, and makes liquids vapor, as it overcomes chemical affinities, as it dissipates magnetic power, changes electrical conditions, and seems to be the great repellent factor in the solar system, we cannot but inquire into the nature of heat, and ask, is it a factor in gravitation? Does it play a part here as it does in all other conditions of the attractive force?

We are inclined to give this query an affirmative answer. But an affirmative answer here requires an abandonment of the current theory of heat. For all scientists are teaching us that heat is but a mode of motion. We are being led to look at it as something real—and the most potent of all the realities in nature. A survey of organic nature and its forces, the forces by which living bodies are builded, and the surrender made in their dissolution, tended the more to confirm this view and to demand a new hearing of the whole question as to the nature of heat.

As this investigation was made about nine years ago, I am not sure that I can follow the lines of inquiry as they were followed then, but an important question was, whence the heat of friction? The conclusion reached was that it is from electricity. Some of the reasons for this conclusion will appear as we advance.

At this point I reviewed the discussion of physicists on the nature of heat. The old emission theory, though crude, and in some respects faulty, was, I thought, too readily abandoned. Count Rumford's cannon-boring experiment had undue influence. While it covered a very little, it was allowed to determine a great deal. It showed that the heat that came from the friction in boring did not come out of the iron chips, or in any way deprive them of former capacity as to heat. But did it prove anything more? It simply established a negation; a negation of narrow limits. And yet it is paraded as having cleared the way for an entire new departure; and as conclusive against what had been the received theory. If heat is a constituent of electricity, if electricity pervaded and enshrouded the cannon that was being bored, and every part of the machinery used in the boring, and if it is possible under certain conditions to have electricity surrender its heat, we may claim Count Rumford's experiment as confirming the theory here advanced. His experiment suits no man's theory, or purpose, better than mine.

I followed on through all the recorded experiments, and they all seemed to illustrate and confirm my position.

Convinced that the heat of friction is from electricity, and that heat is not motion, but that it is an entity, a substance, I found it in harmony with true philosophy to speak of immaterial substances. A substance is that which underlies attributes, or manifestations. Any being with relations so discerned as to distinguish it from other beings is a substance. Throughout the centuries it has been agreed among the learned, that there are corporeal substances and also spiritual substances. The best intellects of the world to-day recognize both of these. Finding that there was nothing absurd in the idea of an immaterial substance, I was ready to place heat under this category. Are there then in nature substances corporeal, and substances incorporeal? Under the first do we have matter, and under the second heat?

Allowing this as a hypothesis, we determine farther, that the one substance, matter, is inert, powerless, destitute of all known properties. The other substance, heat, is active. It is self-repellent, and this self-repellence is one of the mighty forces of nature. From this self-repellence comes repulsion in all its forms. These two substances have an affinity for each other, and this is the other of the mighty forces of nature. In this affinity, attraction in all its forms, and in all its degrees, has its origin. Repulsion is co-extensive with attraction, and these two are so related that they are ever in conflict, the one tending to bring things together and to keep them together; the other tending to put them apart and keep them apart. The above are both imperishable forces; constant forces, always the same when conditions are the same; their manifestations changing as the conditions change, so that the direct of the one is the reverse of the other.

If the above propositions are established, we have in them the key that unlocks all the mysteries, and explains all the phenomena in connection with inorganic nature. Here we learn what gravitation is, what its origin, and we get more correct knowledge of its laws.

With these propositions before us, let us look at nature and see if we are justified in accepting them.

From the densest of metals to the rarest of gases there is a law of contraction and expansion. All bodies are expanded by the application of heat. Here we have the repellent. They are all contracted on its withdrawal. They all have a capacity for heat. Each after its own measure absorbs heat without increase of temperature. They may all be vaporized, or thrown into gaseous form. But in this change an immense amount of heat affiliates with the atoms of matter. And in this condition they fill many times the space formerly occupied. Here we have both the affiliation of heat with the matter, and the expansive power of heat in separating the matter. The more the heat is applied, the more room is demanded; the expansive force, the self-repellent force, bursting the confines and filling vast regions of space. This is found everywhere in nature. The binding force that binds substances together is under law, each substance having a measure of its own. Each having a law of its own with regard to the rise of temperature, each a law of its own as to the amount of heat it appropriates without rise of temperature, and a law of its own as to the amount of heat required to accomplish certain results. But in all cases heat is king. It unlocks every barrier. It determines every new condition. It dissipates into the realms of the invisible, masses of matter, by enshrouding itself in gauzy garments too attenuated for observation. In the taking up of these particles of matter we see the affinity between heat and matter. In the carrying of them away we see the repellent power of heat. Were it not for the attraction that causes the atmosphere to press as an ocean on the surface of the earth, this self-repellence would dissipate it through all space. In everything we have these two elements, heat and matter, differently compounded. In metals we have most matter and least heat. In liquids less matter and more heat. In gases we have least matter and most heat. And metals are more or less refractory, liquids more or less volatile, and gases more or less attenuated, in proportion as the one element or the other, heat or matter, predominates in its composition.

Wherever you touch the science of chemistry you find these positions illustrated and confirmed. Here every gas, simple or compound, has its appropriate measure of heat. Two simple gases have more heat than their compound requires—so in their union heat is given off. All chemical changes are accompanied by corresponding changes of heat. Our theory would require this. Chemical combinations produce heat, because here the more attenuated resolve themselves into the more compact, and heat is set free. Chemical decomposition causes a disappearance of heat, because here the one compact substance is resolved into two that are more volatile, heat being the element that is necessary to the new condition. We have this law, the combination of any two bodies chemically, is attended by the evolution of a quantity of heat equal to that which disappears in their separation.

Most chemical changes are complex. In them we have both decompositions and recompositions. Here both the *minus* and the *plus* come in, so we have this

great law, that in all combinations effected through the simultaneous decomposition of compound substances, the heat evolved in the case is equal to the difference between these *plus* and *minus* quantities. It is the *resultant* of that which is given off by the combinations, and that which is appropriated in the decompositions.

Let us not forget, that in all these chemical changes, heat is as much a factor, as measurable a factor, and a factor as definite in its operations, as any other element known in chemistry. Yes more, every law in chemistry results more from it than from any other element.

In combustion we have dissolutions and chemical combinations. Ordinarily oxygen combines with the matter said to be consumed. The oxygen going into the new combination surrenders a portion of its heat. Hence the heat of combustion. And in perfect accord with our theory, we have this rule, that in ordinary cases the heat of combustion is proportionate to the amount of oxygen required in the burning. If the combustion is of two gases, as oxygen and hydrogen, they both surrender portions of their heat. Hence the intense heat in the case. The heat of combustion is of like origin with the heat in other cases of chemical recomposition. Here the same law prevails. The difference is in this alone, that the conditions here are such as to produce luminosity. The reader will see how perfectly all this harmonizes with the theory here advanced.

Again, as all solid substances can be vaporized, or decomposed and their elements thrown into gaseous form, as this can only be done by means of heat, and as in every case, in the process, a definite amount of heat becomes latent, these gases may be regarded as composed of matter and heat. We have the heavier gases, and the lighter. We know that the heavier gases contain more matter, and the lighter gases less. The lightest gas known to us, hydrogen, is fourteen and a half times lighter than the air, yet it contains matter, being one of the constituents of water.

Beyond hydrogen our observations are limited. The substances that lie beyond are too subtle for us. Yet there are, doubtless, lying in this region subtle gases unknown to us. Beyond all, and crowning all, we have the rays that come to us from the Sun. By the solar spectrum these are divided into heat-rays, color-rays, and chemical-rays. Analogical reasoning may lead us to suppose that these chemical-rays are composed of matter and heat. For not only do they behave like other chemical elements, but, like the gases, they can be made to yield their heat, latent heat, to yield it in great quantity. So electricity lying somewhere, as a half-way point between hydrogen and the chemical-rays, is composed of heat and matter, the heat latent till disengaged. Returning to the spectrum, passing on beyond the chemical-rays, and the color-rays, we have the heat-rays: the heat here being more intense. In the color portion of the spectrum the red is hotter than the yellow, the yellow hotter than the green, the green hotter than the blue, the blue hotter than the violet, and the violet hotter than the chemical-rays. These color-rays, like the chemical, can be thrown into heat. Then in the color-rays also, there is *latent heat.* Now if the analogy holds good,

every colored ray has in it a degree of matter. Least in the red, more in the yellow, still more in the green, next in the violet, and then most of all in the chemical-rays. And so you may go on, through electricity and through the gases. And here is the basis for Delong's and Pettit's law of specific heat. The relative quantities of heat and of matter entering into the composition of gases is the very principle that this law takes cognizance of. The bearing of all this on the question, and its beautiful harmony with my whole theory will be at once perceived.

Now about electricity. Electricity is a gas which we cannot handle in the gas form. But so strong is the affinity of some gases for matter, that they mass themselves on the surface of bodies. For example, a bar of platinum becomes covered with a blanket of oxygen. It may be wiped off, it may be driven off with heat, it may be coaxed off by putting the end of the bar in a chemical mixture for which oxygen has a strong affinity. There is a law about this massing. Only a heavy metal can master and bind a heavy gas. Platinum sponge has a great capacity for condensing hydrogen, and observe, in the condensation, heat is given off, so that a hydrogen gas-jet lights itself, by heating the platinum sponge against which the gas strikes. A small lump of charcoal will condense within itself more hydrogen than will fill an ordinary room when free. From this condensation of gases we sometimes have the heat that causes spontaneous combustion. All these things confirm my theories; but I mention them here to help us understand electricity. Electricity is the most abundant of all gases. It is in all the air, and in the regions above the air. Its affinities are such that it can be massed by almost anything. There is a blanket of it around almost everything you touch. It is held in every degree of mobility or rigidity, according to the nature of the body to which it adheres. The degree of attractive force in each case determines the texture of the coating, and from this we have the scale, from good conductors to good insulators. And from this also grows that other scale, from bodies most highly positive to lowest negative. Electricity is not only on the surface of bodies, but it enters the pores and pervades all bodies. Sound is conducted by it, and the rapidity of the conduction of sound in different bodies, the distance to which the sound will be carried, and the loudness of the sound, all depend, other things being equal, on the different electrical conditions of the bodies through which the sound is transmitted. There is no reason why, with the proper use of electricity the telephone, like the telegraph, may not convey its messages around the world.

Electricity in the gas form is next of kin to heat. And see its affinity for matter. And see also its self-repellence when free. Like the other gases, yet exceeding them all, in the strength of attraction, and in the force of the repulsion. I see no necessity for two kinds of electricity. We give the name electricity to the subtle gas or gases found massed upon solids. In the attraction that masses them we see their affinity for matter. We see this also in the experiment of the pith balls. If one be charged, and the other not, there is attraction, because of this affinity. If there be contact, there is equilibrium, as concerns the balls; but

as both are now slightly charged, there will be slight repulsion. Charge both balls to their full capacity, and we have strong repulsion, because now the repellent element is in excess on both. Here, as all along, we find the heat element self-repellent. We have the clearest proof that attraction results from the affinity between the two elements. In attraction, we may be allowed to assume that the potency is in the heat.

Now let us for a moment look at the question: Is the heat of friction from electricity? This question should now require but a short argument. Observe, it would have been impossible to have insulated Count Rumford's cannon. And the heating of that water was a small affair, when we consider the nature of electricity. It will be found that friction between bodies that hold electricity with a degree of rigidity will develop most heat. And it will be found that every lubricator is something for which electricity has the least possible affinity. Glass is coated with electricity, and water is charged with it. So when Prof Tyndall pours water, or mercury, from glass to glass, and tells us the *motion* makes heat, we may object. So again, not only his bullet, but his anvil and his sledge are all coated with electricity; and when he tells us that the sudden destroying of *motion* makes heat, we may object. The woodman's saw, when not greased, has a blanket of electricity on either side of it. Of course it will heat by friction. When the woodman gives it a coat of grease he does the best possible thing to keep the electricity off. If you can get an electric spark by rubbing a cat's back, or by touching your toe to the carpet, no wonder you can get it by rubbing two sticks together, or from the steel and flint. You will observe most of Prof. Tyndall's beautiful experiments, illustrating the dynamic theory of heat, were made in connection with the electric pile and the magnet and coil. He tells us that working a saw through a strong current of electricty, it seems as though it were being pulled through cheese, and that it soon becomes very hot. All of which is as we might expect. If the reader wants more proof that the heat of friction is from electricity let him look it up for himself. He will find it about him on every side.

Electricity moving unimpeded gives us no heat. In that case its heat continues latent. It is when it is crowded that heat is given off, as every electrician knows. When it gives us heat some electricity is destroyed, and as a result heat is set free. So color-rays are destroyed and heat is set free. So oxygen is destroyed and heat is set free. Electricity is easily destroyed when it is massed on solids. It can be done by concussion, by friction, and by chemical actions that either appropriate its matter and free its heat, or appropriate its heat and free its matter. It can be destroyed by its own crowding as it passes over defective points of the conducting medium, or by its leaps as it passes from proximate conductors. As the sparks pass from one body to the other, minute particles of the first body are deposited on the second. This shows the strong attraction by which the electricity clothed itself with particles of the metal over which it passes. It shows also that the crowding and concussion destroyed electricity, and caused a depositing of its matter, and as you might expect the result is great heat. As

its current was caused by its own repellent force, we have proof here for every principle I have advanced. Proof of the affinity, proof of the dual nature of the element, proof of the repulsion.

These subtle gases are forever grasping whatever they can lay hands on, and they are running away with all, according to their ability. You cannot see their operations, but your olfactory nerve gives some account of their proceeding and "the half hath never been told."

In connection with odors, all here advanced finds the strongest confirmation. Radiant heat is destroyed or becomes latent in connection with all odors. Passing radiant heat through dry air, nitrogen, or hydrogen, very little of it is lost. Calling this loss 1, the loss in passing it through ammonia is 7260, through sulphuric acid 8800. You may say it is stricken down, but it affiliates with the matter and becomes latent. By passing radiant heat through vapors, still greater differences are manifested. In passing heat through ozone, both the heat and the ozone become lost, as they enter into combination. But enough of this. It is as plain as the sunlight in the heavens, that heat enters into composition with the most infinitesimal particles of matter. This is the atom. Out of these atoms come molecules, and gases, and fluids, and solids.

A few thoughts more may be presented as having some bearing on the discussion. We have the laws of reflection of light, and of heat. This reflection comes from a rebound, or from elasticity, as when a rubber ball is thrown against a smooth surface. We can conceive of the most tiny atoms rebounding. But can a wave rebound? That a motion should rebound is unthinkable. That a wave should rebound is absurd. The reflection of light and of heat seems to demand an atomic theory.

Again, we have the laws of the refraction of light, and of heat. The solar spectrum shows that heat is refracted less than light, and light less than the chemical-rays. That is, the heavier the enswarthment of the heat atom, the greater the refraction. That is just as we would expect. We all agree that refraction results, first, from a check to velocity given on entering the denser medium; and second, from the acceleration obtained on passing out of it. An atom can receive the check more readily than the wave. Will some one please tell us how the wave will receive acceleration on going out? Explain to us how anything, whose motion depends on the force with which it started, being once retarded, will receive acceleration? The thing is absurd. But, on my theory, as all those rays approach the earth, they have new impulse, from that powerful affinity out of which grows all attraction. What better confirmation could we want? And this leads to the remark, that perhaps nature is not so prodigal as to send out into all empty space, the source of blessings that are shed upon us.

I want to say this on radiation. The molecules of water becoming heated, expand and rise. We say they carry heat by convection. So the molecules of air becoming heated, expand and rise. They, too, carry heat by convection. It is well known that the air carries *electricity* by convection. The air-molecule becoming charged, is repelled; at some distant point it unloads its cargo, then returns

again, is charged, and again repelled. Gases too minute for observation may perform the same service for heat, and this may be the philosophy of radiation. Perhaps it is by the speedy flight of the molecules through all solids that heat is disseminated through them. This is more simple than that other theory that asks us to believe that there is an everlasting kicking and stirring of the solid particles. I would not be understood as believing that heat needs a chariot for its conveyance. It is, no doubt, able to travel alone. And alone, its affinity is all the stronger for the object of its pursuit.

How harmonious are the workings of nature. And all fits so beautifully to this theory. Look, for example, at polarization: solids crystalize as they solidify; crystalization being polarization under other conditions. So this thing runs through nature. In the laboratory, the chemist sees polarization in a thousand curious forms. We have the polarization of electricity, the polarization of light, and the polarization of heat. Why not allow the whole class to be of a kind, when they are so alike in their behavior? Wherever we touch these matters this kinship is proclaimed. My theory of affinity and repulsion gives us the philosophy of polarization. The nature of the atom, when it becomes a compound, makes polarization almost a necessity. This theory also gives us the philosophy of radiation, and of elasticity.

What a breaking up of family ties when heat and light are put off into a strange place. Notice the parallelisms. Take latent heat. We have it in solids, in gases, in electricity, in chemical-rays, in color-rays. Take elasticity: We have it in solids, in gases, in electricity, in chemical-rays, in color-rays, and in heat. Take polarization: We have it in solids, in chemical compounds, in gases, in electricity, in light, and in heat. Take chemical factors: The various elements, gases, electricity, chemical-rays, color-rays, heat, all are chemical factors; each definite in its operations in every condition in which it acts.

As to conduction through different metals compare electricity and heat. They are as like as twins. In all the standard books we have the following table of conductivity:

Name of Substance.	CONDUCTIVITY. For Electricity.	For Heat.
Silver	100	100
Copper	73	74
Gold	59	53
Brass	22	24
Tin	23	15
Iron	13	12
Lead	11	9
Platinum	10	8
German Silver	6	6
Bismuth	2	2

If heat is only a mode of motion, then electricity is only a mode of motion. And from their kinship as shown in conduction it must be much the same kind

of motion of the same kind of invisible ether. Electricity and heat are surely very much of the same nature. Is electricity only a mode of motion? Believe it who can.

I will not be surprised if some things that are erroneous shall be found in this paper. I will be surprised if its main positions are not sooner or later accepted by men of science. Those who are too established, to re-invoice the storehouse of their knowledge, will likely remain where they are, at least, till they follow the multitude. But there is a spirit abroad in the land that asks even what is called science to show its authority. This spirit was never more active and more earnest than now, and the truth is going to lose nothing when it goes forth in methods of legitimate operation. I respectfully ask that the themes here discussed receive from this class of minds serious consideration. Having held to these views for the last eight years, I have gone with them into different realms of science, and everywhere they have caused me to see with a clearer light. This is so in astronomy, in geology, in meteorology, and in all that pertains to organic nature.

After all, it is not so much that need be thrown away. Thermodynamics is indeed a science, and here "the half has never been told." Heat is the source of force. It causes motion. It may be said to accomplish work. Yes, surely, if it be the source of all attraction and of all repulsion. Scientists may measure its force, and if they choose they may reckon it by foot-pounds. To all this we have no objection; we are pleased. And we expect to see a great deal more done in these directions. Go on gentlemen, nor stop till you find a perfect system of applied mathematics running throughout the whole physical world. It is there, whether you will be able to gather it up, or not. But all this makes nothing for the theory that heat is only a mode of motion.

SELENIUM AND ITS USES.

Selenium is an elementary substance that is found in nature associated with deposits of sulphur. It was discovered in 1817 by Berzelius. This somewhat rare element crystallizes in four sided prisms, and is about four times as heavy as water. It is as brittle as glass, but, unlike the latter substance, is readily cut or scratched. Selenium, when suddenly cooled from a fused state, possesses a reddish-brown, metallic lustre with a conchoidal fracture, which by exposure to the air, assumes a dull, leaden-gray color. The name, selenium, is derived from the Greek word *Selene*, the moon. When rapidly cooled from a state of fusion, selenium is a non conductor of electricity, but when cooled very slowly it is a conductor. In this latter condition it possesses a granular appearance and a metallic lustre.

It was during the experiments of Willougby Smith that an exceedingly valuable property of selenium was discovered. While making some experiments in his system of cable testing, he was considerably puzzled by the extreme variabil-

ity in the results he obtained. Persistent efforts in tracing the cause of these discrepancies resulted in the extremely valuable discovery that the electrical resistance of selenium was less while exposed to sun light than when in the dark. This valuable discovery was made in May, 1872, and was communicated to the Society of Telegraph Engineers on the 17th of February, 1873. His apparatus consisted of platinum wires, inserted into the opposite ends of a bar of selenium, hermetically sealed in a glass tube. This was placed in a dark box and suitably connected with instruments by means of which its electrical resistance could be measured. When so arranged, the exposure to the light, consequent on opening the lid of the box, caused an instantaneous reduction in the resistance. So sensitive was this arrangement to the action of light that merely placing the hand between the selenium bar and the light of a distant gas burner, instantly affected the instrument.

The discovery of this curious property of selenium naturally attracted considerable attention from scientific men in different parts of the world, and numerous investigations were made concerning its properties, for example: Professor Adams, of Kings' College, showed that the greenish-yellow rays were the most effective in varying the resistance of selenium, and Professor Siemens produced a variety of selenium that was fifteen times as great a conductor of electricity in the light as in the dark.

Among some of the more interesting applications of the variations in the electrical resistance of selenium, by the action of light we may mention the "selenium eye," in which an attempt was made to imitate the action of light on the iris of the human eye. By an ingenious use of selenium resistances, introduced into the circuit of a battery, the inventor caused the intensity of the light that entered a lens to be maintained approximately constant by the action of an electro-magnet that varied the size of the opening of a diaphragm, in this manner roughly imitating the contraction and dilatation of the pupil of the eye.

Perhaps one of the most famous uses of this property of selenium, was made by Alexander Graham Bell, of telephone celebrity. This inventor, in an instrument he termed a telephote, has so utilized the variations in the electrical resistance of selenium while under the influence of light, as to be able actually to hold telephonic communication along a ray of light instead of along the customary metallic wire. The telephote is now generally known under the general name of radiophone.

Numerous attempts have been made, in different parts of the world, to utilize this variation in the electrical resistance of selenium under the influence of light for the transmission of photographs, or, outline sketches, by electricity. Some of these attempts have been comparatively successful, and we may in a subsequent issue discuss them in detail.

We shall not be found wanting in the Exhibition in a display of this curious element. A single exhibitor has applied for space for an exhibit of selenium resistances that he values at $10,000. An application has also been made by a French savant who contemplates exhibiting an instrument called the telectro-

scope, designed to transmit photographic images by means of electricity, by the use of selenium resistances.—*Electrical Review.*

ARCHÆOLOGY.

DID THE ROMANS COLONIZE AMERICA?

M. V. MOORE.

I. PROBLEMS AND FACTORS.—Who first colonized the Western Continent? From what far-off land came the primal pioneer to the shores of America? When and where, and over what trackless seas did he sail?

Who was the mother, who was the father, and what was the language lisped by the first-born under the western skies?

These are profound questions, which have agitated the minds of men for centuries. Science has wrestled long and earnestly with the mysteries surrounding the Red man; but the wisdom of the wisest has failed in reaching any satisfactory conclusions. The voice of History is silent, giving no response to the long-pressed queries, and even the tongue of Tradition tells not its vague and uncertain tale concerning the origin of the earliest peoples of the western world. There remains not so much as a hieroglyphic in which may be traced the faintest vestige of the birthplace or language of their sires.

The Indian is enigmatic. He is the profoundest historical problem of all the ages He is not, however, involved in such mazes of darkness and confusion that there is no clue to the truth. We have well-defined bases upon which to proceed. There are three well-known factors presented in the problems; upon these alone now depend all legitimate calculations if we expect to obtain any trustworthy results.

The prehistoric peoples of America are revealed to us in custom or character; and also in art and in language. There are fragmentary remains of each of these all over the continent. The naturalist takes a fossil, and from that fossil he delineates an extinct species. Can we take the fragmentary remains pertaining to the dead races of the continent, and construct therefrom the skeleton of a truth? The testimonies we have indicate that there was once a people in America possessed of a high order of civilization. The savages of to-day represent the degenerate and retrograding sons of illustrious sires. Hints of the culture of the ancient Americans are yet found in many places in the land. Our prehistoric ruins reflect not only a high order of art, but art founded upon pre-existent models known in old civilizations. This art displays a mind and a hand trained in the schools of science. The civilization and art of the American were yet flourishing when the conquests of the Spaniards, Cortes and Pizarro, put an end to

their vitality. There were—and are yet—visible deep impresses in the character of the Aborigines—the distinct marks of nationality—made by the silent but sure forces of thought and habit for countless ages. These, doubtless, descended from the earliest generations here. They indicate, beyond question, an antecedent type long existent somewhere in history.[1] Thirdly, the language of the earliest colonists of America is full of evidences of illustrious birth. Those people were neither beast nor savage. Their speech was not the gibberish of the untutored barbarian; it was, indeed, a speech which by common consent had origin in cultured minds.

The three factors in our problems are all productive or illustrative of civilization. What era in the world's history does that civilization represent?

The answer to this query—the index to the theory of these papers—lies in the title we have chosen, "Did the Romans colonize America?"

We consider first the most universal of the testimonies reflecting the Indian's origin. We say universal, for whithersoever the man wandered over the continent, he left behind him as a testimonial, the shreds of his language. Let us see if we can unravel the strange woof contained in the words found here representing the earliest peoples of the Western World. Mr. Jefferson in "Notes on Virginia," has said that "a knowledge of their several languages would be the most certain evidence of their common derivation. . . . Were vocabularies formed of all the languages spoken in North and South America, *preserving their appellations* . . . it would furnish opportunities . . . to construct the best evidence of the derivation of this part of the human family." This, indeed, touches the very key-note of the subject. The appellations of a nation are always indicative of their origin. This fact is observable all over the world. German people usually do not adopt French names. Nor does the nomenclature of France savor of Ireland or China. China does not borrow her words from the Hottentot of Africa, nor from the nations of Britain. And whence, then, came the "appellations" of the Aborigines of America?

The most common, and the most universal, and at the same time the most ancient, of the Indian "appellations" have been "preserved." They are the river names of the continent. These words are the very oldest testimonies that exist, delineating the speech of the earliest dominant races in America. Exactly how old they are, it is impossible to tell. But it is well known that they are not the coinage of the rude people found here in the 15th and 16th centuries, any more than that the names of the rivers of the Old World are due to the present nations there. All geographical nomenclature, with rare exceptions, belongs to remote periods—much of it in the Old World, as well as in the New, to the prehistoric ages.[2] The Indian names of our rivers belong to a period when one common language was known, when one dominant race ruled, throughout the

1 See Irving's "Life and Voyages of Columbus," Vol. I, pages 139-141. This authority is quoted as more convenient and accessible to the general reader than the Spanish originals to which Irving refers.

2 The origin of many of the most common European and Asiatic names on the maps of the world is unknown.

entire length and breadth of America. These names illustrate or indicate the language of the men who colonized the continent.

How do we know these facts?

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All the primitive peoples of earth are known to have used in the structure of their river nomenclatures, the same common and universal syllabic expressions, designated as "terms"; and which are the ancient exponents or significants of our words water and river, with their varying conditions. These terms are known to man under every condition of his existence, whether civilized or barbarian; they are traced backwards, through the intervening tongues, to the oldest of all known languages. The American Indian uses the same terms in his river-names that were used by all the aggressive races that overran and colonized Europe, Asia, and Africa.

Writers on language usually denominate that wide embrace of speech which immediately antedates the historical tongues as the Semitic Language.[3] From the Semitic root have sprung three great branches—the Hebrew, the Chaldee (or Aramean), and the Arabic. While each of these has had its countless offshoots and dialects, directly to these three may be traced the historical languages of civilization, and in which are found all the ancient terms for water and river, now known, either in purity or with mere variation and verbal corruptions, in all the river nomenclatures of the world, including that of the Americas. There is no corruption or abbreviation of those ancient terms known to the Oriental or European languages but what an identical word is found to match it in the river names of the Western Continent. And yet not only does the Indian show familiarity with the ancient terms for water and river, but he had knowledge also of other terms unknown to the ancients up to a certain period in historical annals. That period embraces the Latin.

A glance at terms themselves may enable us to have a more definite understanding of the problems before us—a more intelligent idea of the manner in which the Indian showed his familiarity with the tongues of civilization. By comparative illustrations, we may be able to trace the Indian down through all the historical eras represented by Hebrew, Sanscrit, Celtic, Phœnician, Arabic, Persian, Indo Germanic, and even through the Greek into the bosom of the Roman. *And if the testimonies of philology have any value in determining historic truth, we may find the earliest colonists of the Western Continent in a people reaching its shores from what is now a province on the western coast of the Kingdom of Italy.*

Startling as this proposition may seem, it is made in the sober conviction of its truth. But to illustrate fully all the evidences showing the Indian's familiarity with the historic languages of the Old World, from the Hebrew to the Roman,

3 Lying still beyond the Semitic is what is usually denominated the Germ Language—a language of brief roots, or germs, which make up the great body of known tongues. All modern languages are chiefly composite—their composite character obtained from what are now generally regarded "dead languages," with modern types of the old. The dead languages were also composite to a great extent. They were made up of those brief roots which had birth in the primal speech of man—the Germ Language.

would detail upon the writer the task of a volume in itself, occupying more than our allotted space in this paper. Deferring that duty to a future issue, we shall have to content ourselves in this with a few brief examples.

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One of the most ancient river-names now known—Abana of Damascus—contains two of our terms. As this word has never since been applied to the river (at least so far as is known), it is supposed that Naaman the leper, who first used the expression historically, applied the traditional name to the waters—for he was a learned man, supposed to have been versed in the traditional lore of his country.

The two terms in this name are Aba and Na. The actual translation of the word as a Hebrew expression makes it "waters" "sure,"—that is waters that flow certainly, with perpetuity. (Isaiah xxxiii., 16.)

In the Hebrew (where the word is found both as Abana and Amana, the consonants B and M being often used interchangeably) the letter M is the brief significant of the word for water; its full expression is Mo or Ma. (In the original Hebrew the vowels are omitted, and the reader or translator is often allowed to supply the omission according to his own conjecture. So says Gesenius, the great authority in ancient languages.)[4]

Languages which are dialects of, or cognate with, the Hebrew, use varying expressions of the term Aba for river or water. The Sanscrit, which also omitted the vowels, often had Ap as the significant of water. In the Dacian or Wallachian, the word is written Apa. These are the same as Aba, for B and P are often used interchangeably in the languages of old. The Persian expression of Aba is in Ab, with the pronunciation and frequent writing of Aub.

The Arabic of the word is the final syllable, Ba; or, as sometimes written, Bar or Bahr, the latter containing a hint of an additional term known in the river nomenclature of all nations—the Sanscrit word Ri. As the consonants L and R are used interchangeably also in many languages, this latter term is often found rendered Li.

The idea expressed in the primitive term Ri, is that of a restless, rapid, rushing current—a stream, a torrent, or a cataract. Its coinage was perhaps due to an onomatopic principle developing in the mind of the earliest philosopher. The term is found now in the river nomenclatures of every people under the sun, and always expressive of the rippling, rapid water. It has received many differing expressions in the written languages of man. We see it in the Brahmapootra of Asia; in the Nachar and Niger of Africa; in the Rhine, the Rhone, and the Dneister of Europe, and in America it is in Missouri and Niagara, and in countless other river names, not only in America, but elsewhere all over the world. In the name Niagara, Ri appears written with A, while the term Na is rendered with I, the true word being really Naagari (or more correctly still Naoghari. All our Indian words are written in mere conjectural or fanciful orthography, as we shall see more clearly as we proceed).

4 Hebrew Grammar, page 22 (Dr. Roediger). Appletons. 1868. Comp. remarks, page 5, also.

In the name Niagara, an additional factor or term is seen—"aga," or really Ogha.

In the early Semitic or Germ language, there was another word for river, in addition to the term Aba, which is supposed to be often merely *water.* It is, however, impossible now to give the original word a definite expression. The Hebrew, the Sanscrit, and the Celtic have slightly varying orthographies for it. In our ordinary transcripts, or versions, of the Sanscrit, the term appears as Ogha. The English word *ocean* is traced to this term. The Celtic language has the term written Acha, or Achi; and from which the Latin word *acva* or *aqua* comes. These words are given in our lexicons as the significants of water or river.

In the ancient Germanic or Teutonic language of Europe the term has been rendered Aha or Ahha, our authorities stating that this is also a *correct pronunciation* of the Celtic Acha. Writers on language usually refer to the word Aha as the Germanic equivalent of the words Acha, Apa, and Aqua—water or river. Probably the facts are that Aba and the group of terms owing their origin to it, variously rendered in B and P, making really one primitive word, was in the ancient speech the true term for water, while the word written with G, C, Ch, and Q, refers always to the running river, with the possible exception of the Latin *aqua*, which is expressive of either water or river. Aha may be considered simply as the ancient Teutonic expression of Acha, as it is known that defect has existed for countless ages in the German tongues, preventing their pronunciation of certain digraphs in speech—a fact we shall have occasion to refer to again.

There are developed so far but two of the ancient terms for water and river, Aba and Ogha. Na, while not purely an adjective, was expressive of the constantly flowing water. There was another term in the ancient speech expressive of the character of the water. It is the syllable De (often rendered "dee"). It is seen in the Sanscrit words Dena and Deap; and it is supposed to be the root of our English word "deep," this coming, says Webster, from the Anglo Saxon *deop*, the same as the Sanscrit *deap*, meaning the deep waters, as the sea. Dena is the flowing deep water, while Rina, another Sanscrit word, is the rapid flowing water. Dena, Depa, and deap are all analogous if not identical. It is well known that D and T often interchange in languages—one being used for the other. Our authorities state that the Indian word now written Tippa is correctly rendered *Depa*. (See Lippincott's Pronouncing Gazetteer.)

It is scarcely necessary to burden these pages with full illustrations of the manner in which these ancient terms have entered the river nomenclatures of the Old World. They are seen in purity and corruption everywhere there, and they are so imbedded in the historical languages that references are superfluous. One fact should be remembered—the vowel sounds, especially in the terms, are given all manner of writings. This is due to the fact that the expressions of sounds have no common uniform and arbitrary orthographies in the language of men.

In the Old World especially, where *a* is often rendered in *o* and *u*,[5] we see, for instance, that Aba is written Oba and Uba, and Obi and Ubi. These are the names of Russian rivers. We write the same thing in our Indian nomenclature, Obey (a river in Tennessee), and Yuba, a river in California, while in Africa one of the native (Bari) names of the Nile is given as Yubiri—Aba with the addition of the term Ri.

The Persian method of expressing Aba, is in Aub, or Ab, is seen in the Asiatic rivers Punjaub, Murjaub, and Chenaub or Chenab. The term is not confined to Persia alone. France has a river named Aube. There are more than fifty rivers in Europe showing the presence of Aba and Apa in their names. The Indian nomenclature shows a like number. The reader's memory can call up the names. The Persian sound is heard in the names Catawba, Senatoba, Manitoba, and others; while the pure Sanscrit or Dacian expression is found in such names as Apa-lacha, Al-apa-haw, Sax-apa-haw, Caniapuscaw, and in the original of the word Mississippi, which was Messi-apa. The very name Abana is found in the Indian word written Abanay.

In the former of these illustrations (in Apalacha) we see the Celtic Acha in connection with the Sanscrit Ap. In two others we see the Germanic term Aha (haw), and in the three others we find with the ancient term for river prefixes well known in the Latin—prefixes which are unmistakably adjectives of modern birth.

Apa is rendered with O in the European river names, written Oppa (in Italy and Silesia also). It is written with O in the Indian names Opequan and Opelika, and numerous others. The Po (once the *Padus* or Padee River of Italy) gets its title from Apa. The final vowel is often written with O in the Indian, as in Appomatox, Appodee, and in many others. It is written with U also, as in Appuremac.

Aba and Apa are often rendered with the vowel *i*, as in Mississippi, Osippe, Caribee, and Abbatibbe. In the ancient name Jolibah of Africa (once the Niger), and in the Meribah of the Hebrew we see the same term.

The Celtic term Acha is found in a score of instances in the Indian river names in absolute purity, often alone, as in our numerous Hatchies. It is more frequently joined with a modern descriptive epithet. (By the term "modern," as used in this and a previous paragraph, I refer to the historical periods.) We see the Celtic word in Oswegatchie, Caloosatalchie, Choctawhatchie, etc.

Acha is found in river nomenclatures all over the world. In Sicily is a river—the name is pronounced *Atchee*, but the writing of the word there is Acè. Sumatra has Atcheen. Acheen in Germany is pronounced nearly *Ockeen*. Nearly all the German river words showing the Celtic root Acha with the C sounded, give this consonant the hard or K sound. Aach—a river there—is pronounced *Ak*. This pronunciation of the syllable Ach is prevalent all over the world. It

5 It is very common to find in the Old World words which have origin in those primitive languages which were chiefly consonantal in structure, now written with either of the vowel sounds.

is so similar in many instances to the sound of the initial syllable in the Sanscrit term Ogha that it is often a difficult matter to determine to which word a corruption is due—whether to Ogha or Acha, as in the word Niagara. The "aga" here may be traced to the sound of either (though the terms themselves are really one and the same).

This recognized difficulty is more conspicuous in the Indian nomenclature than in the names of the Old World—due to the manner in which we have received the Aboriginal names in America. Yet even in the existent writings of the Indian words we find very striking similarities and analogies every way to these names in the words of the Old World. We have space for but few illustrations in this paper. We notice only a few.

The Indian name Saratoga has an exact counterpart in the Saratowka of Russia. The word Sara itself is in many names in America and the Old World besides.[6] All over the Old World are Garris and Garras. We have in the Indian Garry and Gauriba. All over the Old World are Looris or Luris. The same word is written more than once in our Indian names Luray. Lu is a corruption of Li (for Ri). In African nomenclature the same words are written with either Ru or Lu—as in Rubumba, which is also Luvemba. Africa has the river Ruanna. In our Indian nomenclature the same word shows the Latin root in the way it is now written—Rivanna. The vowel is sometimes written in O, in Africa. We find there the Lowando. In America we have it simply Wando. In Africa is Monongah. In America we have Monongahela—in the "ela," a well-known Latin word is seen. (The meanings of these words will be discussed in future.) In Africa is the Kyogia. We have in New York the Cayuga—pronunciations almost identical.

All over the Old World we find the word Coosey or Koosi, in the river names. There are more than a dozen Coosas in the Indian. The word Moose is also a "native Indian name." Yet in Europe and Asia it is seen written Mousa. The Wolga is a river in Europe; the Wolkee a river in Alabama. In Africa is the Congo. In America is the Concho, and also the Congaree—the Sanscrit Ri added. Sarabat is in Asia; Sarabita is in South America.

The name Mississippi was originally Messisapa, which is not unlike Mesopotamia, of Asia. Our fanciful name Tennessee was once Tenassy (or *Tenacha*), like the other Asiatic word Tenassarim. The Genesee of New York is like the Yenessee of Russia. Yemasie is also similar; Onega of Russia is similar to Oneida of America.

The word Shocco or Soco is in the Hebrew of the Old Testament. It is also a river in Europe. As Shockoe and Saco, it is in the Indian nomenclature from Maine to North Carolina. Saranac is in the New York; Sarawak is in Borneo, and Saramacca is in South America. Chili of South America is heard in

6 Sara is a river in Russia, Switzerland, France, and in Louisiana. It is Sarari in Brazil—another term added. Tigris—*Tegree* or Tiegra—is found in river nomenclature in Asia and in America in several places. Tigre is in Africa.

the Japan river name Pee-chee-lee. Ujiji of Africa finds its likeness in the Jujuy of the Indian.

Oochee (which is a corruption of either Acha or Ogha) is found in many river names of the world—in Russia, China, France, Scotland, and often in the Indian. From this term comes the word written by our early French explorers, Ouachita (now Washita or Wichita). We find what is perhaps identically the same thing in a French transcript of a Polish name—Ouchitza. The name Canoochee of the Aboriginal American, and which is very like the Asiatic word Canojia, gives us a descriptive epithet which is evidently borrowed from the Greek. There are more than a score of the Indian names applying to the rivers bordered by the canes—names having in their structure the Greek *canna*. We shall refer to them again.

The above examples—selected at random, and without any effort to give the fullest analogies in the Indian nomenclature to those of the Old World—certainly convey the idea that the river names of America were not devised in utter ignorance of the language of the Old World. Countless other testimonies could be adduced showing the verbal analogies of the Indian to those of the civilized people of the Eastern Continent. The occasional use by the Indian of similar syllabic expressions, or even coincident phrases and complete words found in the speech of unknown people in remote countries, could be accounted for on the ground of accidentality or otherwise. Yet the nomenclatures of the Red man—his "appellations"—are too full of similarity and actual identity with the words of the Old World for us to doubt for a moment the earliest colonist's knowledge of the pre-existent models. We must confess that there is revealed by the Indian names a knowledge of the historical languages and their etymological laws governing the coinage of words.

We have seen some of the examples of the Indian familiarity with terms having origin in languages antedating the Latin. Let us now see if his knowledge extended through, or embraced the speech of the Romans. Let us see if we can detect in the river nomenclature of American Aborigines a knowledge of idioms and phrases that cannot be traced beyond the limits of the Latin into an anterior tongue. When we shall have seen the testimonials relating to the origin of the earliest colonists of America as they are revealed by the language of those people, we shall then consider the analogies existing in Character and Art.—*Magazine of American History*.

[*To be Continued.*]

DEATH OF "BLACK-BIRD."

A. R. FULTON.

I have read the interesting article of Mr. Collett in the August number of the REVIEW, regarding the death of the celebrated Maha chief, Black-Bird, in

which he concludes from the evidence he gives, that the chief died in the year 1802. Mr. Collett is certainly nearer the date of that event than some other writers to whom he refers. I am inclined, however, to believe, from the record left by the celebrated explorers, Lewis and Clarke, that the death of Black-Bird occurred about two years earlier.

Captains Lewis and Clarke set out on their voyage of exploration from the mouth of Wood River, May 14, 1804. On the 10th day of August of the same year they reached, as they state in their journal, a highland on the Missouri River, near the spot where Black-Bird, one of the great chiefs of the Mahas, died of small-pox *four years before*.. This would fix the date of the death of that chief in the first year of the present century—1800. They described the place of his burial as "a hill of yellow, soft sandstone, which rises from the river in bluffs of various heights, till it ends in a knoll about three hundred feet above the water. On the top of this a mound of twelve feet diameter at the base, and six feet high, is raised over the deceased king." They further record that they placed upon this mound "a white flag bordered with red, blue and white."

Speaking further in regard to the chief, Lewis and Clarke say: "Black-Bird seems to have been a personage of great consideration, for ever since his death he is supplied with provisions, from time to time, by the superstitious regard of the Mahas."

Near the place of Black-Bird's burial the Mahas had a village where four hundred of their warriors died at the time when Black-Bird was taken from them by the same malady. Lewis and Clarke calculate the latitude of this village as 42° 1′ 3.8″ N. Speaking further of the village, they say it was about five miles from their camp (on the Missouri); that it had once consisted of three hundred cabins, "but was burned *about four years ago*, soon after the small-pox had destroyed four hundred men, and a proportion of women and children."

The Indians described to the explorers the dreadful ravages of the malady, which had carried away so many of their people, but Lewis and Clarke could not learn in what way the disease had been communicated to them. They supposed it was through some war party, as the Mahas had been a warlike and powerful people. "When the warriors saw their strength wasting before a malady they could not resist, their frenzy was extreme; they burned their village, and many of them put to death their wives and children, to save them from so cruel an affliction, and that all might go together to a better country." Such is the account given of Black-Bird and the great scourge which came upon his people, by so reliable an authority as Captains Lewis and Clarke.

The explorers remained with the Mahas several days, during which time they obtained much information in regard to their history and their relations with the neighboring tribes. The account which they obtained in regard to the great chief, Black-Bird, is certainly quite conclusive as to the time and manner of his death and burial. The evidence given in their journal quite definitely points to the year 1800 as that in which occurred the death of the great chief and the lamity which destroyed so many of his people.

The location of the ancient Maha village, the scene of Black-Bird's death, was on the Nebraska side of the Missouri River, about twenty miles above the mouth of the Little Sioux River, a stream which flows into the Missouri on the Iowa side. Some hills, or highlands, in northeastern Nebraska, are known at the present time as "Black-Bird Hills," in memory of the great chief who for many years held supreme rule over the destinies of a once powerful and warlike tribe, which has given to the State of Nebraska the name of its principal city—Omaha (O-Maha).

DES MOINES, IOWA, August, 1884.

ENGINEERING.

THE PARIS WOOD PAVEMENTS.

The repairing of the Grand Boulevards has just been completed, and the Parisians are justly proud of their new roadways, which are now covered with wood, and as smooth and clean as a ship's deck. This transformation in the streets of Paris was forced upon the municipal authorities. The very expensive system of sewerage, with its canals and railways, which has long been regarded as one of the most curious sights of the French capital, was greatly obstructed by the immense quantities of sand which every heavy rain washed into the sewers from the Macadam roads. Although the sewers are flooded every day with water from the Seine, it was found impossible to remove the sand which got in from the streets except by actually digging it out, at a cost of more than two millions of francs per annum. Several committees composed of engineers, hygienists and architects were appointed to find a remedy for this obstruction to the sewers, and as a result of the joint investigation of all these worthies, it was finally resolved to abandon the Macadam roads, because they were the source of so much trouble in the sewers.

The Engineers of Bridges and Highways were then sent to London to examine into the system of paving adopted in that metropolis, and they agreed, after much study, to invite the Improved Wood Pavement Company to lay down a specimen of its pavement in Paris. The conditions of the contract were peculiarly onerous, and nothing but a full confidence in the merits of their system could have warranted the company in accepting it. The company agreed to lay down its pavement at the intersection of the Rue Montmartre and the boulevard of the same name—a point dignified with the appellation of the *Carrefour des Ecrases* (Smash-up Square) on account of the immense traffic and crowding there. It was further agreed that the company was to wait two years for its money, which was not to be paid even then unless the pavements were in a perfectly good condition. This was in 1881. The wooden blocks were laid down, and

stood the test beyond the most sanguine expectations. Actual measurement showed that the pavement had not moved one five-hundredth part of an inch during two years, and it was never once repaired, while the asphalt on the same street had never lasted more than two consecutive months without repairs. The stone pavement which had preceded the asphalt was also in need of constant mending.

The repaving of a large portion of the superb drive-way in the Champs Elysees was also done by this Wood Pavement Company, of London. These severe tests demonstrated the perfection of the new system, and a French company was formed which has latterly repaved the Grand Boulevards, the Avenue de l'Opera, the Rue Royale, where night and day there is a stupendous traffic, the Rue de Rivoli and many other of the principal streets and avenues—in all some 400,000 square meters, or about twenty miles of roadway. The system is now being extended to the Boulevard Haussmann, and is to be carried out all through the splendid new quarter on the left side of the River Seine.

The only system now in use here may be briefly described as an artificial stone pavement, perfectly rigid and smooth, covered with wood. In order to pave the roadway it is first excavated to the depth of twelve inches. A foundation of concrete six inches thick, composed of Portland cement, washed gravel and clean sand, is then carefully laid, and made to conform exactly to the contour intended to be given to the top surface of the roadway. Before this concrete is set or dry, a layer of very fine mortar, also made of Portland cement and sand, is spread over it in a semi-liquid state, which leaves a perfectly smooth surface. When dry this artificial stone foundation is almost as hard as granite, and forms an arch extending from curb to curb. All the weight of the traffic is supported by this foundation; the wooden blocks are used simply to protect it, and at the same time to afford to the wheels a smooth, elastic and noiseless way. The English and French engineers lay great stress on this point. On the concreted stone pavement or foundation, then, a wood covering, six inches deep, is placed. The blocks, which are usually 6x9x3, are placed on end in direction of the fibre, directly on the concrete foundation, in rows across the street, leaving a space between each row of about three-eighths of an inch. Boiling asphalt is then run into this space, and forms a species of shoe around each block, cementing them all together and to the foundation. The remaining space between the blocks, about five inches, is then filled with Portland cement grouting. The top surface is covered with fine gravel, and the pavement is allowed to dry.

The company guarantees to keep the pavement in perfect order for eighteen years, the city paying them 5 francs 37 centimes per square meter per annum. Of this the city retains 1 franc 95 centimes per square meter per annum as a guarantee and sinking fund for repairs, etc. At fixed periods—every six years—the pavement is inspected, and if it is found to be in good order, the sinking fund is paid over to the company, and a new sinking fund formed.

The greatest advantage obtained for the dwellers in this crowded capital by the adoption of this pavement (Kerr's system) is the cessation of the crashing

and rumbling noises caused by huge vehicles. The ponderous double-decked omnibuses, with their three stalwart white horses at the pole, go over this new pavement, almost as silently as a swallow skims the air. I am writing this epistle in my office, which is separated from the Boulevard des Capucines, one of the most crowded streets in the world, only by the width of a courtyard with wide entrances, yet no noise of vehicles offends my ears. There is no thunder of Broadway here. The only noise which troubles me just now is made by an energetic French gentleman with rosy complexion, who, seated at a table in a room on the opposite side of the inner court, is crying out: "*Deux mille deux fois! Deux mille trois fois!*" and so farther, as the Germans say. As he is within the precincts of a club, I am doubtless right in imagining that his enthusiasm is not entirely disconnected with cards. But that is merely a passing suspicion. My point is that, thanks to the ædiles, we have reached a pass at which men make more noise than vehicles in Paris. How precious would the wooden pavement be on lower Broadway and on the crowded streets by the water side in New York. I suppose there are more private carriages in this city than any other capital in the world, and it seems to me that they scurry home at all hours of the night. One slumbers with no danger of being disturbed by them. The wooden pavement presents so many advantages over stone and asphalt that it is likely to come into general use throughout Europe. The three years' study of the French engineers in London are accepted by engineers of other continental cities as conclusive. The present pavement is an improvement, or rather the result of a long series of improvements, on the American system, which was introduced into London in 1872. The annuity system of payment adopted here presents advantages peculiarly adaptable to American cities, enabling the abutter to calculate a long time in advance what his charges are likely to be, and keeping him out of the hands of "rings" and other detrimental combinations permitted where city politics are corrupt. Every growing city has much to gain by extending its paving contracts over eighteen or twenty-one years, instead of paving occasional large assessments for the mistakes or caprices of would-be improvers. Experiments are henceforth useless; any municipality following the Paris model will find itself completely satisfied.—*Cor. N. Y. Evening Post.*

RELATIVE RIGHTS OF RAILROAD COMPANIES AND THE PUBLIC.[1]

There have been two recent decisions of our Supreme Court in cases not only affecting very important local interests but also involving questions the solution of which vitally concerns the public welfare. These decisions are in settlement of the controversies in regard to transportation facilities at the Savannah depot and the dismantling of the narrow-gauge railroad between Kansas City and Independence. One question involved directly in one of these cases, and re-

1 From the Ninth Annual Report of the Railroad Commissioners of the State of Missouri.

motely in the other is, in what sense or to what extent is a railroad a "public highway." That it is a public highway is not to be questioned in Missouri. No matter how many conflicting laws or judicial decisions there may be on this subject in other States, the question is settled here by our State Constitution, which declares that "railways heretofore constructed, or that may hereafter be constructed in this State, are hereby declared public highways, and railroad companies common carriers." The coupling together of these two predicates in one proposition assists materially in ascertaining its true meaning. Of course the railroad is not the same kind of a public highway as is the sea, the lake, the river, the canal, the common road, the turnpike, or the street. Neither are any two of these exactly of the same kind, but they are all highways, and adding the railroad to the list, we may affirm of them all—that the citizen is entitled to use upon any one of them whatever mode of transportation may be adapted to its peculiar nature and characteristics, and consistent with the rights of others, or the public welfare. On the street, the turnpike, or the common road he may use for the purpose of locomotion, either his own physical powers or those of any domestic animal, or any mechanical power that does not interfere with or endanger the rights of others; or he may use the vehicles of common carriers running upon these thoroughfares. So, in a more restricted sense, perhaps, as to modes, he may use all aquatic thoroughfares, and with still other restrictions he may use the railroad. In all cases the use is his, subject to such restrictions as, from the nature and characteristics of the thoroughfare, are consistent with the safety and rights of others, or in other words, with the public welfare. He may and he does put upon the railroad his own coach or his own freight car, and demand that for a reasonable compensation the same be hauled by common carriers operating motive power on that line; or he may and he does offer himself or his goods for transportation in the coaches or cars of any common carrier using the line with the vehicles he requires. He may also enter upon the railroad with his own motive power, but in that case in order that he may not imperil the safety or rights of others, he must place himself under the direction of the officer controlling the movement of trains, and implicitly obey his orders.

These are some of the rights which the people have in the railroad, because it is a highway, and we have assumed it to be a highway, because it is so declared in our State Constitution. But if it were expedient to go behind the Constitution, and discuss the question of the *de facto* status of the railroad company in the body politic, and the tenure by which it holds its property, etc., we think it can be clearly demonstrated that all, and more than all the rights we have enumerated belong rightfully to the public, and that the railroad is a highway in fact as well as in law. The railroad company is a corporation, of the non-political or private class, in the form of an incorporated joint stock company, organized for the sole purpose, on the part of the incorporators, of pecuniary profit to themselves; and they solicit the privilege of incorporation, because under it each one of them can invest a portion of his capital in the contemplated business, without jeopardizing the remainder, which he cannot do in an individual or an ordinary

partnership undertaking. This encourages the investment of capital in the projected enterprise, and in order to justify the granting of this privilege, or in other words, to make it consistent with the ancient legal maxim that "All corporations are supposed to be created for the public good," it is necessary to assume that the business enterprise thus encouraged is in itself a public benefit. The application of this rule opens the question whether we have not been too reckless in the creation of business corporations. But in respect to the railroad, this question is not raised. That it is a public benefit is not disputed, but on the contrary most freely and liberally acknowledged. Under the laws of this State any five persons can organize themselves into a railroad company, and by paying into the State Treasury one-tenth of one per cent on the first $50,000 of its capital stock, and one-twentieth of one per cent on the remainder, they can construct and operate a railroad between any two points within its limits, and any real estate that may be necessary for this purpose may be therefor appropriated without the consent of the owner, and for a consideration not agreed to by him, precisely as in the case of other highways; and this exercise of this State's right of eminent domain in its favor, of itself alone, most unmistakably stamps upon the railroad an indelible mark, to be found nowhere else than on public property, and which furnishes the ever present and conclusive evidence that it is a public highway. No one now dare affirm that private property can be taken for other than public use; and in all cases where the use is apparently private, or in part actually so, there is outside of that a much greater public good, or the seizure cannot be sustained in equity. Moreover, we authorize the railroad company to issue its capital[2] stock to an amount equal to its entire cost of construction and equipment, and its mortgage[3] bonds to an equal amount more, so that if its corporators have been competent to conduct the enterprise undertaken by them, and have built a road that can earn a good interest on its cost, they can at its completion, mortgage it to the full amount of its cost, sell the bonds at par, pocket the proceeds and the road will have cost them nothing, except the pittance paid into the State Treasury and the use of the money during the time of construction.

We have, therefore, literally *given* to the companies whatever of private ownership there may be in the roads, and in addition to that we have given them most liberal subsidies from the public funds. To all these favors they are legally entitled, and practically they have realized much more. It is preposterous to suppose, it is an insult to the intelligence of the people, and a denial of their capacity for self-government, to assert that all this most extraordinary liberality has been exercised toward the railroad companies, and towards them alone of all persons either natural or artificial, without an intended and expected corresponding public benefit. There being nothing left in this case for the people to enjoy except the *use* of the roads, it follows that the public use of the railroads, in any mode or manner consistent with the general welfare is the grand benefit expected to result from their construction, and the will of the people in respect to them is but modestly expressed when formulated, in the Constitution of 1875, into the

2, 3 See Section 727 and 765, R. S.

declaration above quoted. Evidently they are entitled to all that this declaration implies; the equal rights of all in terminal and transportation facilities should be most sacredly guarded, and as other highways created by any public authority can be abolished only by the same authority, so this highway created by the State, can be abolished only by State authority.

The railroad company stands before the public in the double capacity of the authorized owner of a thoroughfare and of a common carrier. In the former capacity it is similar to a canal, a turnpike or a bridge company, each of which owns a thoroughfare and collects tolls from all who use it, and in the latter capacity it belongs to the same class as the owners of packet lines and ferry boats, of stages, hacks and drays, who charge their customers according to the service rendered. As to canals, turnpikes and bridges, the universal practice is to limit the tolls upon them either in the charters of the companies or by general laws. If this were not done, their owners could, by exorbitant and discriminating charges, not only impose grievous and unequal burdens upon the people, but they could utterly annihilate the public highway feature in these thoroughfares, and it is to prevent this that tolls are limited by law. This being done, the free competition between a multitude of carriers along each one of them, and all accommodating the same points upon them, would seem to render any statutory limitation of carriers' rates unnecessary. Nevertheless, this restriction is frequently imposed, and as if to show that the right of the law-making power to restrict carriers' rates is absolutely indisputable, it is most frequently done in the very case where competition is the most free, most active and most persistent, viz.: in the case of hackmen on the streets of a city. If it be necessary to so carefully guard the public interest against the evils necessarily resulting from private ownership in public thoroughfares, and against the greed of carriers, in these less important cases, where the injury would be in each case so slight, and would be felt by so few people, it certainly is much more necessary in this case where one particular kind of thoroughfare controls the inland transportation of the entire commonwealth, and affects the cost of living of every family within its limits; a highway upon which one and the same party collects both the tolls for the use of the road and the pay of the carrier, and has, in practice, excluded the total benefit of a general competition and converted a partial one into a positive evil. That the public mind apprehends the dangers of the situation and would guard against them is made evident by the statutes intended to prevent combined ownership in competing lines; and that it regards the regulation of rates as essential to the preservation of the public highway feature in railroads is unmistakably indicated in the very section of our Constitution which declares them to be public highways, the whole of which reads as follows:

"Railways heretofore constructed, or that may hereafter be constructed in this State, are hereby declared public highways, and railroad companies common carriers. The General Assembly shall pass laws to correct abuses and prevent unjust discrimination and extortion in the rates of freight and passenger tariffs on the different railroads in this State; and shall from time to time pass

laws establishing reasonable maximum rates of charges for the transportation of passengers and freight on said railroads, and enforce all such laws by adequate penalties."[3]

If the question be asked, why did we ever grant in special charters to railroad companies the right to fix rates by their directors, we reply that a full and complete answer to this question was made on page eleven of the Report of this Board for 1878, and if that be not deemed satisfactory, we add that at the time these charters were granted the unanimous opinion of the civilized world was, that railroads were merely improved highways, and that competing carriers were to be allowed on each line.

That accounts for the non-restriction of carriers' rates, but not for the failure to limit the tolls for the use of the road, in respect to which it may be said that the liberal spirit manifested in this concession is of the same character as that shown in other legislative enactments upon this subject, and particularly in the munificent subsidies granted for the purpose of securing the use of railroad transportation facilities, which liberality cannot be used in argument against the rights of the people, and does not prove that the Legislature would if it could, or could if it would, barter away the public interest, or in any way restrict the people in their right to use these transportation facilities in whatever mode or manner may be consistent with the general good. We are therefore unavoidably forced to the conclusion that railroad companies are not only subject to all restrictions applicable either to private owners of public thoroughfares, or to common carriers, but that as they alone exercise the functions of both, they form an exceptional class, requiring peculiar and exceptionally stringent regulation.

THE CREATORS OF THE AGE OF STEEL.

BESSEMER, SIEMENS, WHITWORTH AND GILCHRIST.

There is more of truth than poetry in giving to the century beginning with the year 1850 the name of "The Age of Steel." The metallurgical inventions and discoveries which mark abruptly that period have effected a revolution in the industry of the world. Steel is to us what iron was to our grandfathers; what bronze was to the armies that sat in league before Troy; what stone was to the naked savages that dwelt in the caves of Gaul before the beginning of history. The very web and woof of modern civilization is woven out of steel. The production of steel in 1882 was as great as the crude iron product of 1850. The metal is omnipresent; it has replaced iron, wood, brass and copper. The rails, ships, cannon, and machinery of the world are steel. The best definition yet given of man is that he is a tool-using animal; his tools are steel, and the tools wherewith he makes his tools are steel.

As Carlyle says, "We are to bethink us that the epic verily is not Arms

3 Article 12, Section 14.

and the Man, but Tools and the Man—an indefinitely wider kind of epic. Man is a tool-using animal. Weak in himself and of small stature, he stands on a basis, at most for the flattest solid of some half-square foot, insecurely enough; he has to straddle out his legs lest the very wind supplant him. Feeblest of bipeds! Three quintals are a crushing load for him; the steer of the meadow tosses him aloft like a waste-rag. Nevertheless he can use tools, can devise tools; with these the granite mountain melts into light dust before him; he kneads glowing iron as if it were soft paste; seas are his smooth highway; winds and fire his unwearying steeds."

The conquest of the world man is achieving with steel, and who the men were that have put this weapon in the hands of man, Jeans tells us in the book whose title precedes this article.

The two first and greatest inventors in the trade reaped no reward. Dudley in 1618 learned a way to smelt iron with coal, and died in obscurity. Henry Cort, in the middle of the eighteenth century, invented the puddling process, and would have starved but for a pension of £200 given him by Pitt. Honors and wealth, however, were showered lavishly on the bright galaxy of men whose names are enrolled in the list of the creators of the age of steel. The story of their triumphs over matter and circumstance makes one of the most interesting chapters in the history of industry.

Sir Henry Bessemer.—Among the French refugees driven to England by the Terror was Anthony Bessemer. A learned and able man, he speedily accumulated a handsome property, the reward of an inventive ingenuity inherited and developed by his illustrious son. Among many other profitable processes the elder Bessemer discovered that an alloy of copper, tin and bismuth was the best for type metal. His process he kept secret, claiming that the superiority of his type came from the angles at which it was cut. It lasted twice as long as the other types, and sold all over England. The youngest son of this gentleman was Henry Bessemer, born at Charlton in 1813. His first attack upon destiny was made in improving the stamps upon public documents. He invented a stamp which could not be duplicated or detached, which was adopted by the Government, and for which not a penny was ever paid the young inventor. His next work was a machine for making patterns of figured velvet, a type-casting machine and a type-composing machine. While working upon this latter machine he was struck by the fact that bronze powder when manufactured sold for 12 shillings a pound, while the raw material cost but 11 pence. The difference he knew must come from the process of manufacturing, a process which he at once began to study. The article came altogether from Nuremburg in Germany, and no one in England could tell him how it was made. For nearly two years he studied this problem, earning success in the end by his infinite industry. He had not learned to have confidence in the patent laws, and he determined to keep his invention a secret. A friend advanced him £10,000, works were erected, the machinery being made in different parts of England. Five operatives were employed, at large salaries, under pledge of secrecy, and the bronze was turned

out at a cost of less than 4 shillings a pound. To this day, although forty years have elapsed, no one has surprised this secret. Sir Henry Bessemer has years since rewarded the faithfulness of his workingmen by giving them the factory and the business, and they too, have made fortunes out of the trade.

Between 1844 and 1850 Bessemer patented machines for the manufacture of paints, oils and varnishes; for the separation of sugar from molasses; for a drainage pump capable of discharging twenty tons of water per minute; a machine for polishing plate-glass, substituting a vacuum for the plaster bed. Each of these was meritorious as unique, and as profitable as they were ingenious.

This much will show the surprising versatility of the man, and enable the reader to grasp the character that revolutionized modern industry.

The Crimean war turned Bessemer's attention to ordnance, he produced a projectile which rotated without the aid of rifling from the gun, and made many improvements in the guns themselves. The English authorities ridiculed his improvements, the Emperor Napoleon was greatly struck with them and requested Bessemer to continue his experiments at the expense of France. At one of the subsequent tests Commander Minie said: "The shots rotate properly, but if you can not get a stronger metal for your guns such heavy projectiles will be of little use." That remark produced the Bessemer process for making steel. He knew nothing, absolutely nothing, about metallurgy; he had no idea how any improvement was to be made, and yet he resolved to attack this problem of steel making and solve it.

Prior to 1740 the best steel was made in Hindostan, and cost £10,000 a ton. A watchmaker named Huntsman, after a long course of experiments in that year, produced equally good steel, which could be made at £100 a ton, and for a century Huntsman's process had been used without improvement. In the English process before 1740 the bars of iron were heated with a cement of hardwood charcoal dust, which added carbon to the metal, and made what is called "blistered steel." The heating had to be continued several days. This was as yet unfit for forging and the bars had to be broken into lengths of about eighteen inches, raised to a welding heat and hammered with a "tilting hammer," a process which produced good steel. Huntsman took the blistered steel, broke it up into bits, and put it into crucibles with coke dust, fused the whole, and so made cast steel.

When Bessemer began his work this process was the only one in use. The iron had first to be melted into pigs, the pigs heated with carbon into blistered steel, the blistered steel broken up and re-melted with carbon into steel ingots in crucibles which could not hold more than thirty pounds each. Bessemer's experiment produced first a cast iron better and stronger than any known before.

At the end of eighteen months the idea struck him of rendering cast iron malleable by the introduction of atmospheric air. A great many experiments followed, all of them moderately successful. Mechanical difficulties almost insuperable stood in the way. At last he constructed a circular vessel three feet in diameter and five feet high, able to hold 700 weight of iron. He bought a pow-

erful air-engine and ordered in a quantity of crude iron. This was a Baxter House, a place to be ever memorable in the history of the steel trade. The apparatus was ready, the engine was forcing streams of air into the openings in the fire-clay-lined vessel, and the stoker was told to pour in the iron as soon as it was sufficiently melted.

The metal was turned and a volcanic eruption ensued; such a blaze of dazzling fire was never seen in a work shop before. Corruscations of fire filled the chamber. The metal flowed down and the air burst through it upward, breaking away in great bubbles of living glory. A pot-lid hanging over the blaze disappeared in the flame. All this time the air was rushing into the molten mass and no one dared to go near to shut it off. While they were debating the flame died down. Soon the result of this wonderful pyrotechnic could be examined. It was steel! Seven hundred weight of steel made from the melted pig without crucible, coke dust, or charcoal. Seven hundred weight of steel born simply of fire and air!

The British Association met in the following week, and Bessemer read a paper describing his process, exhibiting at the same time his results. It was on the 11th day of August, 1856, that this public announcement was made of the new method. The whole industrial world was aroused by the tidings. Bessemer's paper was reproduced in the *Times*, and the iron trade examined the discovery with infinite interest. Experiments were made in a great many foundries, and the sole talk of the hour was the new way of making steel. Within three weeks after reading his paper at Cheltenham, Bessemer had sold £25,000 of licenses to manufacture under his patent. The Dowlais Iron Company was the first to begin the manufacture. Bessemer personally directed the construction of the works. Again the molten iron was poured into the receptacle, again the air blast bubbled through the metal, the gorgeous display of Baxter House was repeated, everything went well, but the result was not steel—it was nothing but a very good cast iron.

Those who had praised the new process now ridiculed it. The failure was inexplicable, but it was a failure, and exactly six weeks after the publication of the article in the *Times* a meeting of iron-masters at Dudley condemned the Bessemer process as a practical failure.

The inventor was not dismayed. Patiently and hopefully he set to work to find the flaw which had spoiled his work. A long series of experiments followed before he found the cause of his failure. By mere chance the iron used on the occasion at Baxter House, when steel was made was Blænavon pig, which was exceptionally free from phosphorus. The metal used at the Dowlais works contained this element. Here he found the cause of his failure. He set to work to eliminate the phosphorus by the puddling process, but while doing this there arrived an invoice of Swedish pig iron, clear of the obnoxious substance. Under his original process this yielded steel of such a high quality that he at once abandoned the effort to dephosphorize ordinary iron and began to manufacture from

the Swedish import. Sheffield steel was selling at £60 per ton; he could buy Swedish pig for £7 and turn it into steel at a very small cost.

Steel is pure iron with a small percentage of carbon to harden it. The line of demarcation between steel and iron is a difficult one to trace. Following the discoveries made in India by J. M. Marshall, Bessemer introduced ferro-manganese into his cenverter and the pure iron was at once carburized into steel.

The public, however, had lost confidence in Bessemer; he had spent his private fortune, he had made steel, the point was now to sell that steel. Through the assistance of Mr. Galloway, Bessemer bought in the licenses which he had sold, works were erected, and steel produced at a profit at £42 a ton—Sheffield was selling at £60. This argument was unanswerable—the Bessemer process had won, the iron-masters took out licenses under it and the age of steel began.

The revolution spread over Europe and America; the process was especially popular in Sweden, where the Crown Prince superintended its first trial. In Prussia Herr Krupp, the great cannon-maker, agreed to pay Bessemer £5,000 for a license. With Bessemer's papers Krupp applied to the Government for a patent, the patent was refused, and no royalty was ever paid to the inventor. Belgium and France appropriated the new process, and declined to recognize Bessemer.

Bessemer had attacked the problem of making steel for the purpose of having a better gun-metal than any then existing. Accordingly he returned to his experiments with ordnance. Steel cannon were cast with a tensile strength of thirty tons to the square inch, figures much greater than had been reached before. A number of tests were ordered at Woolwich, but through rank favoritism the matter was submitted to Sir William Armstrong, a rival cannon-maker, and very naturally an adverse decision was rendered. The Government would not touch the new metals, and Bessemer for the time being let the matter pass, concentrating his attention upon the industrial uses of steel, a field large enough for the ambition of any man. In 1861 he induced the London & Northwestern Railroad to put down some steel rails as an experiment. In 1881 these rails were still in good condition—iron rails had to be turned once in nine months. The next step was the substitution of steel for iron in ship-building; the next, an invention of steel projectiles, which were found to penetrate the iron armor of ships as easily as the old iron balls went through wooden vessels. At this time Bessemer was receiving £100,000 a year from his business, but his inventive faculty was not let lie dormant. The best known of his later devices was a ship built with an automatically balanced cabin in order to do away with sea-sickness. This was a theoretical success, but a practical failure. Henry Bessemer's life-work was the production of steel from cast iron; all the other many achievements of his mind were, after all, but side issues. In the first twenty years of the life of his invention he had saved to the industry of the world over a billion pounds sterling—that is, the work of one man did nearly twice as much to build the wealth of the world as the American civil war did to pull it down—indeed, figuring upon the actual saving made, Bessemer's invention had saved enough money to humanity

by 1882 to pay for the American civil war, the Franco-Prussian war, the Austro-Prussian war and the Italo-Franco-Austrian war of 1859. The inventor had been made a knight of the Order of Francis Joseph, he has been given the Grand Cross of the Legion of Honor, but the British Government declined to permit him to accept it. Out of the enormous benefits of his invention there has come to the inventor a fortune for himself. When his patent expired in 1870 he had been paid in royalties £1,057,748. Added to this, his Sheffield works divided in profits during their fourteen years' existence fifty-seven times the original capital, and the works sold for twenty-four times the original capital. In 1879 Bessemer was knighted by the Queen; honors were showered upon him. His services to humanity were recognized at home and abroad. All of the great cities of Europe conferred their freedom upon him, and, what caused the utmost pleasure to the inventor, a town in Indiana whose chief industry was based upon his invention was named for him, assuring him the only immortality that he desires—the constant record of his memory among the men for whom he worked.

SIR WILLIAM SIEMENS.—Next to Sir Henry Bessemer among the creators of the age of steel stands Sir Charles William Siemens, who was the philosopher of the new era as Bessemer was the inventor. After becoming a thorough student in electricity, Siemens' first exploit which attracted general attention was the invention with his brother of the system of anastatic printing, a process by which any old or new printed matter could be reproduced. This was rather a *success d' estime*, than a money-making discovery, although it brought the young inventors into European notoriety. The method consists in applying caustic baryta to a page of printed matter, changing the ink to a non soluble soap, and then applying sulphuric acid to precipitate the stearine. The paper was then pressed into a slab of zinc, making an intaglio from which copies could be easily taken.

Siemens next perfected a method for greatly increasing the heating power of furnaces by compressed air, the results being of immense practical value to the trade. The very high temperature which he was thus able to gain, at a small cost of fuel, naturally was applied to the working of steel. His method is called the "open hearth process." In this process the charge consists of pig iron, which is placed on the bottom and around the sides of the furnace. Melting requires four or five hours, then the pure ore is charged cold into a bath in quantities of four and five hundred weight. Violent ebulition ensues, and when this ceases more ore is put in, the object being to keep the boiling uniform. Spiegeleisen or ferro-manganese is added and the charge is cast. The result is steel. Siemens' first improvement was a rotating furnace, in which coal and iron are put together, and mixed and heated so thoroughly that the result is all that could be desired. So thorough is the process that the hitherto irreducible iron-sands of New Zealand and Canada can be worked to a great profit.

Coming into direct competition with the Bessemer product the open-hearth steel has held its own, its consumption in the United Kingdom rising from 77,500 tons in 1873, to 436,000 in 1882. The Lindore-Siemens Company rolls the armor-plate for the British Admiralty, and the steel has been found to be even

better than the Bessemer for general ship-building. In 1883 one-fourth of the total tonnage of new ship-building was built of Siemens steel.

Sir Wm. Siemens and his brother, Dr. Warren Siemens, of Berlin, have been called the pioneers of modern electrical research. The dynamo-machine is theirs, and much of the development of the electric light. Henry Siemens has put on record a series of experiments in electro-horticulture, which show astonishing results. In the hostile English climate he has produced ripe peas by the middle of February, raspberries on March 1st, strawberries February 14th, grapes March 10th; bananas and melons showed similar results.

The German electric railway is one of the enterprises of the Siemens. They are the builders—the creators—of the Indo-European telegraphs, reaching from London to Teheran, in Persia. The history of this enterprise, with its dangers braved and its difficulties overcome, is one of the most interesting of this interesting book.

The Siemens laid the first submarine cable in 1847 from Deutz to Cologne, covering their wires with gutta percha. The services of Sir Wm. Siemens to science as well as to the useful arts can not be too highly appreciated. Beside his industrial triumphs he reconstructed our theory of heat. Wealth and honors came to him, but in the midst of his career he was cut down. An accidental fall on a London pavement, November 5, 1883, ruptured the nerves of his heart and he died a fortnight later, his death being mourned as a national loss in England and Germany.

Sir Joseph Whitworth.—Joseph Whitworth's first industrial exploit was the production of true plane surfaces in metals automatically, an achievement perfected in 1840. The old method was grinding with emery powder and water. He planed the metals with a steel plane. "So exactly can surface plates be made by his apparatus that if one of them be placed upon another, when clean and dry, the upper will seem to float upon the under, without being actually in contact with it, the weight of the upper plates being insufficient to expel except by slow degrees the thin film of air between their surfaces. But if the air be expelled the plates will adhere together, so that by lifting the upper one the lower will be lifted along with it, as if they formed one plate."

Whitworth was essentially a tool-maker. No sooner had he perfected the plane with its immense effect upon English industry than he attacked the screw. His system of screws is now adopted all over the civilized world. Following up his improvements he recognized the necessity for a more exact measuring machine than any then in existence, and supplying this want he devised a machine which would measure distinctly and practically to the 40,000th part of an inch, and theoretically to the 1,000,000th. To show to what exactness this was brought we quote his own words in an address at Manchester in 1857. "Here," said he, "is an internal gauge having a cylindrical aperture .5770 inch diameter, and here also are two solid cylinders, one .5769 inch and the other .5770 inch diameter. The latter is .0001 of an inch larger than the former and fits tightly

in the internal gauge when both are clean and dry, while the smaller .5769 gauge is so loose in it as not to appear to fit at all. These gauges are finished with great care, and are made true after being case-hardened. The effect of applying a drop of fine oil to the surface of this gauge is remarkable. It will be observed that the fit of the larger cylinder becomes more easy, that of the smaller more tight. * * * It is thus obvious to the eye and the touch that the difference between these cylinders of one ten-thousandth of an inch is an appreciable and important quantity, and what is now required is a method which shall express systematically and without confusion a scale applicable to such minute differences of measurement." The Whitworth gauges have been adopted by the Government as standards of measurement.

The accuracy in mechanical processes rendered possible by Whitworth's inventions bore its first fruit in a direction which the inventor little expected.

England was engaged in the Crimean war, and the Enfield rifle, a hand-made weapon, was the arm of her forces. It became necessary to have these guns in large quantities, and the burning question of the hour was how to make these rifles by machinery. The science of projectiles was then entirely empiric. Some guns shot well and some shot ill, but why these were good and those bad no one knew. Whitworth went before a Parliamentary committee, and told it that until the data of rifling were established good machine-made guns would be impossible. It was necessary to find out what made an effective gun by continued experiment before anything else was done.

England needed a million rifles. To make these by the processes then in use would have taken Birmingham twenty years. It was agreed that the Government should bear the expenses of Whitworth's experiments.

A gallery was set up at Rusholme, 500 yards long, furnished with tissue paper screens in order to track the bullets throughout their flight, and with sliding targets. The experiments began in March, 1855. The Enfield rifle had a bore of .577 inch and the rifling had one turn in 78 inches. The first result was that in every particular the Enfield was found to be wrong Whitworth made barrels with one turn in 60 inches, one in 30, one in 20, one in 10, one in 5 and one in 1 inch. To be brief, he determined conclusively that the best rifle had one turn in twenty inches, a minimum diameter of forty-five inches, and a rounded hexagonal instead of a circular bore. After beating all other guns at short ranges the Whitworth rifle had a deviation of about 4.62 feet at 1,400 yards. The Enfield could not hit the target at all. With a steel bullet Whitworth's rifle perforated plates of iron half an inch thick at an obliquity of fifty degrees, and easily passed through thirty four half-inch elm boards.

Applying the same principles to artillery, Whitworth devised a gun which threw two and one-fourth hundred weight of iron six and a half miles.

To such a great superiority did he bring artillery, first by his invention of compressed steel, next by making the guns breech-loading, and finally by increasing the size of the powder chamber, that it began seriously to be doubted whether any armor could be made able to resist the crushing force of the square-headed

Whitworth projectiles. Whitworth himself attacked the new problem and in 1877 prevailed. He made plates of compressed steel, built in hexagonal, each of which was composed of a series of concentric rings around the central disc. The rings prevented the spreading of a crack beyond the one in which it occurred. Of this material a target was composed nine inches thick, supported by a wood backing against a sandbank. In front a horizontal iron tube was put to receive the fragments of the shot. Against this target a Pelliser shell, weighing 250 pounds, was fired point blank from a nine-inch gun, with fifty pounds of pebble powder, at a distance of thirty yards. This shell would have passed through twelve inches of ordinary armor; against the new target it was shattered into innumerable fragments. The target was drawn back eighteen inches into the sand. The fragments of the projectile escaping at the end of ten tubes continued their rotation in such a manner as to cut through the planks in front of the displaced target. The only piece that survived the shock was a flattened mass of eight pounds, formed from the apex of the shell and left imbedded in the target, where it had made an excavation of eight inches in diameter, and four-tenths of an inch deep in the deepest part. The ring which received the shot was not cracked.

This experiment alone effected a revolution in naval armament.

There is not room here to speak of Sir Joseph Whitworth's eminent services to the cause of technical education. He has devoted a large part of the great fortune won by his inventive genius to the founding of schools and scholarships for the benefit of young men desiring to explore the wide field of mechanical industry.

Sidney Gilchrist Thomas.—It will be remembered that the Bessemer process failed after its first success, and that the reason of that failure was the presence of phosphorus in the pig iron. Such an insuperable obstacle did this present that Bessemer gave up the problem and went to Sweden for his pig. To Mr. Sidney Gilchrist Thomas belongs the honor of discovering a means for getting rid of this obnoxious element. Acting upon his idea, he and his cousin Mr. Gilchrist, the first twenty-six, the latter twenty five years old, conducted an exhaustive series of experiments to find a base with which phosphorus would unite. A base is the name given in chemistry to any element for which an acid has affinity. At last they made bricks of lime and magnesia, which they subjected to an intense white heat, when they became hard as flint. With these bricks, which were a base, they lined their converters, the melted pig iron was poured in and the phosphorus at once left the metal and attached itself to the bricks. A quantity of lime is added to the run, and the result is a thoroughly dephosphorized iron.

The news of the new process spread through Europe, and to show how greatly the invention was appreciated the following circumstance is detailed. A continental iron-master called on Mr. Thomas at 7:30 one April morning to arrange for terms for the use of the patent. Just as they were concluded a telegram was handed to Mr. Thomas stating that another iron-master from the same

district was coming to arrange terms. The first visitor had secured a monopoly and the second man was too late. Both of the iron-men had come over on the same boat; one had driven straight to the patentee on landing, the other had gone to get his breakfast.

Before the process was three years old it was the means of producing half a million tons of steel per annum.—*Globe-Democrat.*

THE ISTHMUS CANAL.

Mr. Theodore H. Growney, a practical engineer, who has been for two years employed on the Panama canal, has returned to San Francisco, and gives a rather discouraging account of the work. He says that there has been an enormous expenditure of money without any commensurate results. Every step taken in the prosecution of the great enterprise has been characterized by prodigal waste and inconceivable mistakes. The company spent a large sum of money in building up the town of Colon, at the Atlantic terminus, which should have been devoted to digging the ditch. The town would have grown of itself with the progress of the work. It is essentially French in its architecture, population, language, and, in fact, in all its characteristics.

The first division of the canal extends from Colon to Gatun, seven miles. It was supposed that all the digging on this division could be done with dredging machines, and the contracts were made accordingly. At the end of two miles, however, the machines struck a coral reef, whose existence was not suspected, and they could do nothing more until a passage was cut through the reef. The dredges were floated over the obstruction at high tide, but the canal has not yet been cut through the coral. The machinery is wearing out, and a great deal of money will have to be expended in replacing it before much effective work can be done.

The second section extends from Gatun to Palo—four miles—and runs through rocks, alternating with swamps and jungle. Nothing has been done on this section yet except to clear away the surface obstructions, and consequently not much money has been spent. From Palo to Fijole the line of the canal has been marked by clearing away the timber and leveling the hillocks. The ditch must be dug through red clay and rocks. A good deal of money has been expended in making roads for carrying the dirt to dumping places. About $4,000,000 has been expended in preliminary work between Fijole and Chagres.

Mr. Growney goes over the whole twelve sections and gives the condition of each, and the summing up of the whole is anything but encouraging. Colossal blunders have been made in the original estimates which put the costs far beyond anything that has yet been conceived of. Up to June 28, 1884, according to the engineer's estimates, $50,000,000 had been expended. The route through the Emperador section was changed after $3,000,000 had been wasted in experimental work.

The most extraordinary blunders seem to have been made by Count de Lesseps himself in his estimates. For instance, De Lesseps contemplated a perpendicular cut on the Culebra section 283 feet deep. It has been ascertained, however, that the banks must have a slope of at least fifty-four degrees, and this will involve the removal of many millions of cubic feet of earth over and above the amount contemplated in the estimates. The cost of this cut was fixed at $10,000,000, but it will exceed $20,000,000.

Mr. Growney has no hope that the canal will be completed within the century, and he says that if De Lesseps were to die the whole project would collapse. —*National Republican.*

EDUCATION.

SCHOOL AND STATE.

C. W. STEVENSON.

In the midst of a great political conflict like the present, when all governmental policies are discussed throughout the land, the great underlying principles should not be forgotten. The theories of parties should not blind us to the fact that American life is full of crying evils and that in the thoughtful mind grave fears arise as to the ultimate result of free government. What are the needs of the hour, and whither are we tending?

The past shows that governments by the people have been of short duration. Democracies have been their own destroyers, and the history of the rise, progress, decay and fall of the Grecian and Italian Republics is but the mournful story of the enervation of prosperity, the triumph of party over principle, and of a venal populace made the prey of despotic chieftains from without and of ambitious leaders and false patriots from within. It is the boast of the nineteenth century that the past one hundred and eight years of American independence has at last demonstrated the beneficence of a government by the people and for the people. We behold with pride the stretch of empire having for its heart the matchless valley of the Mississippi; we love to gaze upon the material wealth and architectural splendor which everywhere greet the eye; and the glory of our educational institutions, our religious and political liberty, the purity and protection of our laws, and the peace which we enjoy with all the world, together, render the words "I am an American citizen," the proudest utterance vouchsafed to man. But the forces which under an intelligent administration of popular rule serve to maintain a Republican form of government, misguided, become surcharged with evil, and the immediate cause of its downfall. And if we but look a little deeper into the workings of the system under which we live, we will find

that there *now* are dangerous tendencies in American life which are indeed alarming. There are clouds in the national sky, white and high sailing, now perhaps, but which if lowered must spread havoc and ruin among the ranks of men.

In the evening of the nineteenth century we are abreast of the experience of the world through all the past in the forms of government and yet there are those among us who believe in a limited monarchy. In a government where the people are the sovereigns we see ignorance among the masses. Super-refined ideas of liberty are endangering that freedom which is the servant of law. Abstract speculations concerning the rights of property, in the hands of the uneducated, would unsettle all the laws of the ownership of lands. The landing of the Mayflower has become almost a myth and we have drifted so far from the policies and practices of the pilgrim fathers that not a popular election passes without witnessing the priceless ballot made an engine of corruption. The laborer is protected in his life, liberty and property, and yet with the granaries of the world from which to draw our sustenance the red hand of commission has been thrust more than once in the face of the law. With cereals rotting in the sun, values are inflated. In the multiplicity of our industries, vocations await the choosing, and yet capital is as merciless to our poor as an Egyptian taskmaster to the creeping drudges that built the Pyramids by the Nile. With millions of tons of coal and iron from which to manufacture the machinery of the world, thousands of hoarse throats are demanding an increase of wages, and the tramp is abroad in a land of plenty. The freedom of the press, established that the purest ideas of the best men might stir a patriot's heart in time of peace, is now used to engender party spirit, and sends forth the stories of the blackest crimes upon the wings of the wind. There is profligacy and theft in high offices, patronage and spoils have become the object of success, and the highest gratifications are sacrificed upon the altar of party-supremacy. Religious freedom is guaranteed to everyone, but the speculations of pseudo-philosophers threaten vitue itself, and would have us disregard civil to say nothing of sacred laws. Social laws are being disregarded. Divorce threatens the institution of the home, and, polygamy-like, a canker grows upon the heart of the body-politic. Reforms, the delirium of an hour, sweeping with the rapidity of a prairie fire, serve only to dry up the heart. Materialism and Agnosticism threaten to loosen the soul from even its moral moorings. A mad death-dance of new ideas unsettles all belief. A feverish unrest has taken possession of the people, and the accumulation of wealth is made the sole end of living. Aristocracies are growing and every decade more firmly establishes Plebeian and Patrician castes. Luxury, ease, effeminacy, fashion, ostentation, the pursuit of pleasure, title and rank and gold, are the moving spirits of existence, and the centralization of power, the despotism of ambition, and the oligarchy of wealth threaten the stability of our institutions.

The Parthenon and Panthenon are but the melancholy monuments of a glorious liberty lost through the same influences which are about us now. All the past is eloquent with the wrecks of nations. Shall we allow these insidious evils, and they are menacing evils if there are any parallelisms of history, to creep upon

us like the sleep of death? Every year leads us further from the ancient landmarks and increases our responsibilities.

> "Revolutions sweep
> O'er earth, like troubled visions o'er the breast,
> Of dreaming sorrow; cities rise and sink,
> Like bubbles on the water; * new empires rise,
> Gathering the strength of hoary centuries,
> And rush down like the Alpine avalanche,
> Startling the nations."

If we perish, it will be by our own hands, and the fate of the American Republic lies in the hearts of all the people. How then may we perpetuate this beautiful fabric? All the immortals who framed that wise compact, the Constitution, relied upon the universal intelligence of the people. Washington in his farewell address said: "Promote then, as an object of primary importance, institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened."

Much need then for the common school!

Here indeed is "a government which gives force to public opinion!" To do this is to make man a free agent, to give him the right to think, and to express his thoughts in shaping his own government. No stream can rise higher than its source. The ignorance of the one-man power, the king, has built the tyranny of the ages. Will a government founded upon the ignorance of the many be less fatal to the wants of man? Ignorance is slavery. It has forged every link in the chain of oppression since the world began. It has pressed down every thumb screw, revelled upon every rock and at every stake through all the dynasties of the past, reared its dark throne in the dungeon's cell. Education is liberty and light. *This* civilization is its most beauteous flower. It has built the cathedral dome and the hall of justice. It has steeled the brain and warmed the heart. One morning, not long ago, it touched its zenith. Reaching out, with sublimest wisdom into the infinite air above us, it caught the slumbering lightning there, and freighting it with America's sweet message of sympathy, flashed it underneath a thousand miles of ocean's brine to comfort a sorrowing mother's heart, the Queen, Victoria, mourning for the Princess Alice. Here is a government giving force to public opinion—shielded with an invincible constitution, that, strong in its provisions, beautiful in its symmetry, the ark of our political safety and the bulwark of our freedom, for over one hundred years has carried us on through storm and disaster and death to the infinite possibilities of the present. Much need then for the future of an intelligent people, of an enlightened public opinion!

A recent writer on the constitution says: "America, free, happy, and enlightened as she is, must rest the preservation of her rights and liberties upon the virtue, independence, justice and sagacity of the people. If either fail, the Re-

public is gone. Its shadow may remain with all the pomp and circumstance and trickery of government, but its vital power will have departed." Speaking further and pointing to their future he says: "In America, the demagogue may arise, as well as elsewhere. He is the natural, though spurious growth of republics; and like the courtier he may, by his blandishments, delude the ears, and blind the eyes of the people to their own destruction. If ever the day shall arrive in which the best talents and the best virtues shall be driven from office by intrigue or corruption, by the ostracism of the press, or the still more unrelenting persecution of party, legislation will cease to be national. It will be wise by accident, and bad by system."

Look about you! Even now the wheels of government are jarring. In a valley, before whose annual wealth-producing qualities, the valleys of the Nile, the Euphrates and the Amazon dwindle into utter insignificance, is heard in unmistakable portent, the cry of oppressive taxation. New parties, the mush-room growths of an hour, spring full armed with all the fatuous principles of immediate salvation into the arena of political strife. Designing leaders, with glittering pictures of sudden reform, whose throats are hoarse with preaching the miraculous deliverance of the dear people, are lashing the sea of popular feeling into waves of excitement, that threaten to loose us from all the revolutionary landmarks. Senates are disrupted over the appointment of a single officer. It is claimed that with all our boasted freedom we have no power upon the high seas, and less than our due prestige among the nations of the earth, and with all the civil questions that arise from the conflicting interests of fifty millions of people demanding a nicer adjustment, legislative bodies are thrown into fever-heat and days upon days of discussion over the re-instatement of some military chieftain.

And yet in a government where all good comes from the people, according to a late census, over five and a half millions of persons over the age of ten years could neither read nor write. Of our adult males seventeen per cent were illiterate and of our adult females twenty three per cent. Again, fifty per cent of all the criminals are deficient in education, and a high authority speaking of the United States says that "One-third of all the criminals are totally uneducated, four-fifths are practically uneducated, and the proportion of criminals from the illiterate classes is at least ten-fold as great as the proportion from those having some education."

Statistics further show that "the proportion of paupers among illiterates is sixteen times as great as among those of common education," and that an important relation exists between education and health. Think of it in a land where the ballot is the only king, the balance of power is in the hands of the uneducated. Our domain is wide, and in addition to our native illiteracy, thousands of the lower classes of other nations are crowding to the polls. Time was when there was only the East and the North, now there is the West and the South! Is self-preservation a less primal law with nations that with individuals? If public virtue and citizenship rest upon the education of the masses, should not the State

compel the education of her subjects? Surely the need of the present hour is a broad intelligence grounded in the hearts of the people.

We are all of us parts of the mighty whole. Your voice and my voice form a part in the destiny to come. Your vote and my vote help to frame the massive structure of our laws. Those who have gained the heights and are looking back upon the thousands yet toiling to reach the high plain of truth and virtue and knowledge should send all the succor of a strong government to aid them mount the steeps of ignorance. Storms are brewing. If the State do not educate the children, let her beware the hour of peril, when to their hands shall fall the reins of government. Spread wider the influence of the common school. Guard it with the strong arm of the treasury. Why, in the Congress just closed at least ten pension bills have been introduced and one important educational measure! See that the teachers of the child that is to bear the burden of the State are taught. Can the hand of a dauber paint the "Madonna" of Raphael, or the hand of a blacksmith chisel the "Minerva" of Phidias? We educate commanders of men at Annapolis and West Point; should the great army of pupils be without leaders that are trained? Certainly, he, who, from the State's point of view, says that the teacher can take the delicate tablet of the child's mind and write upon it the eternal characters of love and truth and knowledge without being a consummate artist, is a traitor to his country and unworthy the civilization which gave him birth.

If the abuses about us give rise to a wish for a limited power to control the operations of State, then it is evident that there are defects in our system. Let us educate more with reference to the State! Let the child lisp with its first numbers the words "Home" and "Country." From Kindergarten to University, teach the ethics of citizenship. Abstract mathematics will never make a patriot. Mere knowledge is cold, let it be more of a stepping-stone to an understanding of the laws of society. Better to be without grammar than without political economy. Teach the "Why" in history rather than the "How" and inculcate the lessons of peace rather than the lessons of war. Repeat ever and always the political story of the Revolution. Teach more of the laws of the land and speculate less about the inscructable laws of nature. If you dissect a flower or tell the sermon in a stone, teach also that all the bright infinity about us beats responsive to the heart of man with love and tenderness and truth. Crown the ever present "Now" with the gems of the good, beautiful, and true.

Under the present school system of the United States, too little attention is paid to the education of the citizen. We should begin early to teach of government and of our relation to the State. New men are acquainted with all the laws that environ them. Remember, that a large per cent of our school children leave school at the age of fifteen to enter the workshop and the store and to labor at the plow. If they do not learn here of the varied institutions of our government, is it true that they may learn without bias from the public hustings?

Oh, there are minds to be fed. Thousands have never yet seen the light of truth. The prince and the pauper are alike slumbering in our midst while arrant

politicians are weaving the warp and woof of destiny for the generations that are moving on to take their place. The child in the mine, and the child in the gas-lighted parlor, the child of the hungering beggar and the child of the devotee of fashion, the child on the high road to prison and the child climbing the convent walls, the child of the faro dealer and the child of the stock-gambler, whose homes are dark with poverty and want and toil, or rich with sparkling gold and bright with folly's ease, will never learn therein the duty which they owe to righteous law. With horizon lifted but a span, the shrunken circle of their lives is filled with self, and as the ship of state sails on, they laugh or curse, and little care who guides the craft, as long as freedom lasts and suns are bright and winds are fair, the puppets of designing men, the heavy freight of human dross.

Let not the State become a painted ship upon this painted ocean of moral degradation, indolence, ignorance, and politic l death. A little freedom may become a dangerous thing. You say that from the northeast there come the muttering thunders of a deadly war between Capital and Labor. Is it not possible to lift the one up to the softened tenderness of the other. If we could but teach those who control the millions of the earth the value of a single human soul, think you that capital would oppress the virtuous poor? But what, you say, can the State do? Religion alone can compass this Who can improve the mind when the body is racked with toil from morn till night? Can the State expect intelligence from its subjects when it does not provide from out the beautiful sunlight of heaven a single hour in the day when the groping mind may turn to science, or literature, or politics? Speed the time when the law shall lay its hand upon unfeeling wealth and say "the laborer is worthy of his hire;" respect thou the untutored child, and know that honest toil shall not be measured by the greed of gold. Let the State answer the question of the English Dickens, "Oh, ermined judge, whose duty to society is now to doom the ragged criminal to punishment and death, hadst thou never, man, a duty to discharge in barring up the hundred open gates that wooed him to the felon's dock, and throwing but ajar the portals to a decent life!"

The question of wages and wealth is paramount with us now. The inalienable rights of life, not passive animal existence, of liberty—not freedom of body but of the thinking soul to soar starward, of the pursuit of happiness—not to accumulate property, but to search with unwasting energy for the highest good—are threatened with destruction, and if the State does not preserve them whole and true, the doom of the Republican idea is sealed forever. Long ago, Charles Dickens, who from the dust in the highways of life searched out the pearls, wrote:

"If those who rule the destinies of nations would but remember this—if they would but think how hard it is for the very poor to have engendered in their hearts, that love of home from which all domestic virtues spring, when they live in dense and squalid masses where social decency is lost, or rather never found—if they would but turn aside from the wide thoroughfares and great houses, and strive to improve the wretched dwellings in by-ways where only pov-

' may walk—many low roofs would point more truly to the sky, than the loftiest eeple that now rears proudly up from the midst of guilt, and crime and horrible iseases, to mock them by its contrast. In hollow voices from workshop, hospi-il, and jail, this truth is preached from day to day, and has been proclaimed for ears. It is no light matter—no outcry from the working vulgar—no mere ques-on of the people's health and comforts that may be whistled down on Wednesday ights. In love of home, the love of country has its rise; and who are the truer atriots or the better in time of need—those who venerate the land, owning its ood, and stream, and earth, and all that they produce? or those who love their ountry, boasting not a foot of ground in all its wide domain?"

The fault with our public school system is that we educate too much the ind and too little the heart. Freedom of religious worship does not forbid the tate from becoming a great moral educator. It is because of this same want at the Nihilism of Russia is propagated by the students of the universities. nd there can be no wonder at the mad resolve to exterminate the aristocracy nd organize society anew, for there the serf has no voice in the national councils, o star of hope upon which to fasten his faith, nothing in the future but slavery r if he disobey the behests of the Czar, the mental and moral leprosy of a Sibe-an exile. But here the serf is a sovereign if the State can but point out the way. 'each them not only the duties of the citizen to the State but of the man to ociety.

This is pre eminently an age of doubt. And when the State essays to edu-ate, let it not be forgotten, that, "all private virtue is but public good." Shake-peare said:

> " There is a mystery in the soul of State
> Which hath an operation more divine
> Than breath or pen can give expressure to."

That mystery is the soul of man. Oh, who can tell what life is? Here—ome "Little Nell" laughs sweetly in the sunshine, and whispers of love—there, e winds of winter are whistling keenly through the gray locks of some maddened ear; here is a station of honor; there is a past of shame; here is a poet's statue Westminster Abbey; there, somebody's darling is buried in a potter's field; ere is the heroic patience of a broken heart; there, a plunge into the dark river; ere, the lowly follower of the holy Nazarene; there, he who taking his burden r a pillow "lies down to dreamless sleep." Ah,

> " Happy the many to whom life displays
> Only the flaunting of its tulip flower;
> Whose minds have never bent to scrutinize
> Into the maddening Riddle of the Root,—
> Shell within shell, dream folded over dream."

The ocean of human life is never at rest. Between "two eternities," strug-ling against the bars of circumstance, striving to pierce the wavering gloom of e unknown, human life, faint with the oppressive environment, from the great

solitary deep of thought cries "whither and whence." Religion, like a sunrise upon storm-tossed waters, says "peace, be still," and hope nestles in the human heart. Science, with a loud voice, makes Reason say "thou knowest not," believe only in knowledge, and Doubt becomes the autocrat of the present. A great conflict is going on Sacred citadels of faith and creed are hard beset by the armies of reason and discovery.

Let not the smoke of the conflict cloud the vision. There are some laws of action true in the nature of things. *These, the State should discover*. The Republic of Rome fell with the fall of her gods. How many of the reckless lives about us stranded every day upon the rocks of crime, fall through the utter vacancy which follows in the track of materialistic and agnostic tendencies?

Robertson has said: "It is an awful hour when this life has lost its meaning and seems shriveled into a span; when the grave appears to be the end of all, human goodness nothing but a name, and the sky above this universe a dead expanse, black with the void from which God himself has disappeared. In that fearful loneliness of spirit, when those who should have been his friends and counsellors only frown upon his misgivings, and profanely bid him stifle doubts, which for aught he knows may arise from the fountain of truth itself; to extinguish as a glare from hell, that which for aught he knows may be light from heaven; and everything seems wrapped in hideous uncertainty,—I know but one way in which a man may come forth from his agony scatheless: it is by holding fast to these things which are certain still,—the grand, simple landmarks of morality."

More than eighteen hundred years ago there was born into the world a creed of love and duty saying—"love thy neighbor as thyself"—beside the purity of which, the codes of Confucius and Buddha, the Light of Asia, become but glittering baubles of oriental fancy. If it be not the province of the State to do more, while the "now" is being drowned in the wild search for the secrets of the future, then through all the net-work of the schools, let it lift high this banner, upon which is written in letters of light the word "Humanity." Then as Tennyson wrote:

"Let knowledge grow from more to more,
But more of reverence in us dwell;
That mind and soul according well
May make one music as before."

But the school is not the only agency by which the State may elevate the moral and intellectual tone. The prison and the hospital, the stage and the stump, the press and the public library may be made more ennobling. Look at your prison-houses! *There*, is need of radical reform. Now, they are great arsenals of trade. Hundreds are at work—a task unfinished, the lash or the blind cell follow. A half hour's religious service on Sunday at the muzzle of a repeating rifle, the only food for the soul. A government of fear! But read the mental transformation which Victor Hugo paints in the character of Jean

Valjean, who for seventeen years toiled as a galley slave for stealing one loaf of bread, and you will behold the demons which the State manufactures every day. Can you wonder that the convict goes forth with a hell in his heart, to prey upon his fellow? Wipe out forever the miserable doctrines that they should be self-sustaining, and tax the pure in heart that those who have committed the crimes may be shown the way of life, and inaugurate more of the reign of love.

Redeem the stage. Let virtue and peace beware when the populace applaud the scandals of life when rehearsed before the glare of the footlights. But the play has its audience no less than the pulpit. It may be made to touch the heart and generate noble aspirations when all else fails. Keep its teachings pure. Away with the tawdry representations of the hour when the terrible night-rider and the debauche of society are paraded before the public mind. Let character be the burden of the story recited, and orchestra, dress and scenery be but exquisite settings in which to present an ideal life.

Again, if we would have the ballot the potential factor in American politics, let the press above all other means of our popular education, banish from its columns the baneful evil of party spirit. Principles are the only vitalities which may organize men into parties. With the telegraph and the railroad, the press has become a household treasure, and the home and family are banned or blessed as its tone is pure and wise, or slanderous and unpolitic. Its freedom should not be compassed alone by the will of man, but rather by the will of the State.

This is the most "solemn experiment" in human government the world has ever witnessed. If there are abuses and neglects in government about us now, we should stay the tide while yet we may. If ignorance is an evil which forms a standing menace to good government, then look well to our schools and all the ennobling influences of our civilization. It is easier to tear down than to build up. A breath of tyranny, the revolution of a single day, the proscription of a single prerogative, may bear us swiftly to anarchy and ruin. The past remains unalterable. It is a "lighthouse in the great sea of time" and no act of ours can dim the lustre of a single star in the galaxy of the revolutionary heroism. But other generations will judge our work. We must account to the future for the "blessings which have been transmitted to us." Let us not "quench the light which is rising upon the world. Greece cries to us by the convulsed lips of her prisoned, dying Demosthenes; and Rome pleads with us in the mute persuasion of her mangled Tully." But if an enlightened people shall preserve the pure principles of our forefathers as a princely heritage to those of another day, what imagination can picture the ineffable glory that may surround the human mind in the century to come. To what liberation of soul, to what surpassing civilization, to what peace of government shall the world bow down. If king there be, his throne will tremble and the humblest peasant in far off Siberian waste will feel the thrill of life run through his soul, and if he shall but make the school and the press the arbiters of our destiny, perhaps soon will be realized Joaquin Miller's wondrous prophecy of the West: "The sea of seas shall rave and knock

at the Golden Gate, but this shall be the vineland, the place of rest, that the old Greek sought forever to find. This will be the land of eternal afternoon."

THE TEXT-BOOK AS AN ELEMENT IN SCIENCE TEACHING.

PROF. GILBERT B. MORRISON.

When a child first awakens to consciousness he finds himself surrounded by a world of wonders, a world of varied forms and forces of which he is himself a part. This has been the common experience of every intelligent child since man first inhabited the earth. The extent of the individual man's knowledge and understanding of the multitude of material objects—animate and inanimate—in their manifold relations to one another and to himself, fixes his real standing as a scientist, for science is the knowledge of the facts of nature systematized as to their relation, agreement and difference, cause, etc. The extent of any individual's understanding depends on the age in which he lived, the native ability possessed by him, and the character of the influences surrounding his life.

The process of systematizing the world's knowledge has been long and laborious, each age and generation contributing its mite. The first condition of any material progress from age to age lies in the record—the recorded mental experience—of each age for the use of the next. Without such recorded experience no progress could be made, for then each child would begin where his father began, instead of where his father left off. The ideas of all who try to interpret the appearances of nature, without first availing themselves of ancestral experience as recorded in books, are about as crude and primitive as are the earliest records of the ancients. To properly direct the young in their efforts to understand, interpret, and utilize the facts, phenomena and forces of nature is the business of the teacher of science. Now, the chief means in this process is the text-book. I am aware that lately much has been said and written intended to lead to a conclusion directly opposite regarding text-books and to make them secondary and unimportant factors in science teaching. Because text-books are often misused in the hands of teachers who know not how to use them—teachers who teach by pages and not by subjects, stuffing the memory and neglecting the reason—many have been erroneously led into the belief that text-books are the next thing to useless, and that pupils should "study nature for themselves." This pedagogic re-action that has led well meaning and enthusiastic teachers to the extreme of condemning the principal means of scientific teaching, has resulted from the prevalent abuse of this means by not connecting it sufficiently with the objects it treats, to make it understood and, therefore, of any value. One of these extremes is about as censurable as the other. One leads to encyclopædic, stultified cramming, the other to diffusion and dissipation A text-book in any department of science is supposed to treat its subject in a general way—to state clearly the main principles of the science, preceding each by a sufficient number of examples and facts to

make these principles understood. I only refer to those text-books prepared by authors who know how to teach, and not to those whose arrangement violates the proper method of presentation. The mistake has been not in teaching the text-book too much but in not teaching it enough—in not teaching it properly. In the short time given to the study of each branch of science in our schools that course should be pursued which will best prepare the student to continue the studies thus begun or to engage in the activities of a business life. What will best prepare the student to continue the study thus begun? Some say take him into the woods and let him "study nature for himself." Others will quote Prof. Agassiz, who is reported to have said to some pupils who came to him for instruction: "I hope you have not brought any books, I don't want you to read."

A child who "studies nature for himself," with no definite plan marked out for him upon which he can concentrate his powers of thought, will see and notice as many things of minor importance and of no relevancy to the subject at hand, as things that will lead to unification and generalization. He perhaps collects together a lot of trash, takes it home and calls it his cabinet. He reaps a harvest of bugs and butterflies, and thrusts pins through their sensitive bodies in the name of science. His mental impressions and conceptions will be made wholly on appearances. His classifications will be made with reference more to appearances then to organic structure and tissue, for it took ages of accumulated experience to reach such a method of classification; and our little "investigator" is denied this because it is "second-handed" and may not be true. He perhaps acquires a mighty zeal in his work. It is easy and a good deal like play to wander in the woods and "collect specimens." He goes on till his collections swell to formidable proportions; and if he does all this without the aid of a text-book he will be as much of a scientist as Adam got to be.

If there is anything for which we have reason to be thankful it is that we live in an age that makes science possible ; but nothing like true science is possible with a boy who pursues the above described course. I would not be understood as depreciating the value of cabinets and historical collections. On the contrary, my appreciation of them and their true place in teaching, I shall try to make apparent in the course of this discussion. How then shall the pupil in the short time allotted at school get the best possible start? I shall precede the answer to this question by a quotation from Wm. T. Harris, who is probably the profoundest thinker in pedagogics in this country: "The business of a school," says this thinker, "is to enable the pupil to help himself to the accumulated experience of the race as found in books." Why did he not say: as found in nature? Simply because, although the principles of scientific truth have existed since man began his existence here, it has taken the combined mental activity of the race thousands of years to find them out. Whatever method then will best enable the pupil to appropriate understandingly what is now the common property of mankind is the true method. Some one has said "that the business of the teacher is to teach the pupil how to read." When this is understood in its full meaning it contains all there is in teaching. There are more pupils leave school who do not know

how to read than there are who can not conjugate a Greek verb, or identify the geological formation on which they stand. I mean by reading simply *getting thought from the printed page.*

Now, teachers who are so enthusiastic on teaching nature instead of books, say the children do not understand the books, and then make that a reason for quitting them. As tersely stated by Herbert Spencer: "They by their method induce stupidity, and then straightway make that stupidity a reason for their method." They would say: "Come, children, it takes a 'conscious effort' to understand this author, let us take a romp in the woods and discover these principles for ourselves." They romp, see many pretty things, collect some shining shells, kill some pretty birds and come back refreshed and invigorated in spirits, but perhaps no better able to understand the "horrid book" than before. They will in this way learn many interesting things and profit by the exercise, but still be unable to read—to get thought from the book. They leave school without this ability, and though they may be sharp observers, their observations will be superficial, for they are not deepened by the thoughts of great scientists whose language is the text-book which they have never learned to appropriate because it required a "conscious effort." Any possession, mental or material, that does not cost effort is not worth the having. It is effort and *conscious* effort that makes men. The tendency to relieve pupils of effort and the neglect of that kind of training which teaches them *how* to make it, is weakening the efficiency of our schools.

I will now try to make myself understood regarding what I believe to be the proper use of the text-book. I do not mean that its use is measured by the number of facts it contains, nor that the chief object in mastering it lies in the bare knowledge it imparts; but that its mastery implies the ability to *read*—to interpret recorded thought. The mere facts memorized from a text-book with no understanding of the principles they teach are of course worse than useless; and their incumbrance on the mind is even less beneficial than an aimless ramble in the woods; and it is this use, or rather misuse, of text-books that has resulted in the re-action represented by the misguided advocates of no text-books. But how shall the text-book be understood? How shall the teacher make it an efficient means in scientific pursuit? How shall he make it a stimulator and not a deadener? A complete answer to these questions would embody the definition of a true teacher. Whatever is required beyond the pupil's own resources to enable him to understand the subject at hand must be furnished by the teacher. The value of the teacher lies in seeing just what and how much is needed, and how to apply it. An occasional pupil will be most benefited by receiving no aid at all. He studies the subject from the book, thinks about it, verifies when practicable by experiment, criticises if thought necessary, observes its bearing on the experiences of life, masters the entire thought of the author, and if his taste leads him to be a specialist, having thus appropriated ancestral experience, he is able then to pursue the subject independently and add his might to scientific progress. But the majority of pupils will need some aid from the teacher to enable them to read the

scientific record—to study the text-book profitably. The pupil's eye is the index to his thought, and the teacher knows when to supply aid; and a few apt questions will serve to determine the kind needed.

Now, the more the teacher's resources are aided by illustrative apparatus and properly arranged cabinets, the better. Objective representation for what cannot otherwise be conceived should always be at hand, and much depends on their judicious use. Should collections, objects, apparatus and illustrations fail to penetrate the understanding of pupils exceptionally dull, the teacher is then, to the extent of his time, justified in "taking to the woods," with the sole object of clearing up the dark point, returning when this is accomplished in order to avoid the mental distraction of noticing too many things at once. Pupils want more concentration and less diffusion. A continual and unnecessary interposition of objects may cultivate perception but it sacrifices imagination and reflection.

The extreme notion that pupils should be relieved from books in scientific study, is only a single phase of object-teaching, the perverted use of which is now foremost in the ranks of educational crazes. True objective-teaching is not here assailed, but only that perverted use of which it maintains that a thing can not be known unless the learner is subjected to bodily contact with it. The use of objects in teaching is to bring subjects of thought within the grasp of the imagination. When the time arrives in the pupil's mental evolution, that a subject can be clearly and accurately conceived without a material illustration, any intervention of the object consumes time and weakens the noblest faculties of mind. To know just when the object can profitably be dispensed with, is a vital element in teaching. The continual parade of objects whose properties are already well known to pupils is as disgusting to them as the absence of those they cannot understand is discouraging. There are good and well meaning teachers laboring under the delusion that a pupil cannot know a thing without having exercised his senses upon it. Let us see where this notion pursued to its ultimate consequences will lead us. Taking the single branch of zoölogy as an example, this theory would limit the knowledge of the naturalist to those animate forms which he could personally see, examine and dissect. If his knowledge of the animal kingdom by this means ever became considerable, he would have to spread himself even beyond the possibilities of a specialist in this one study.

Now the fashionable and senseless custom that justifies the mutilation by every student of science, of all forms of defenceless animal life that is available, would be amusing were it not for its barbarity. This foolish aping of the scientific specialist who is adding useful data to his special branch, by tyros in science who have not even learned the first principles of classification is, to say the least, an inexcusable and misguided zeal. In studying anatomy the pupil should have clear notions of the essential elements of animal structure. The nature of bone, tissue, fluids, and organs can be known by the close examination of a single animal taken as a type. If the modifications of these elements as found in other

[illegible] drawings, then the work of [illegible] that bodily contact is neces- [illegible] science, and see how it [illegible] of Kansas City learns that [illegible] in the latter city a [illegible] Our Kansas City archi- [illegible] proceed? If it is true that [illegible] journey to Philadelphia, [illegible] on his own legs, measure [illegible] architectural proportions [illegible] that such a proceeding [illegible] do? The design by the [illegible] would convey to the [illegible] size and necessary detail; [illegible] as it stands—an image worth [illegible] protracted tramp first sup- [illegible]

[illegible] specialists, who are laboriously [illegible] It is intended for [illegible] composed of pupils preparing for [illegible] studied, in its propor- [illegible] and reflective powers of the [illegible] powers to the extent of neg- [illegible]

CORRESPONDENCE.

[illegible] IN COLORADO FOR 1884.

[illegible], COLORADO, August 13, 1884.

[illegible] be a very mistaken impression abroad [illegible] business in Colorado, arising proba- [illegible] with the mining business of the [illegible] excitement, arising from new, and for- [illegible] of ore-bodies yielding in a short period vast amounts [illegible] and mining men, as well as eastern investors, are [illegible] mining business is, and can be made legitimate; [illegible] and attention are paid to the details as are given to [illegible] to make it a success.

At the present time the speculative part is from perfectly natural causes per-
y eliminated, which causes may be stated as the result of greater knowledge
ng men generally as to the requirements to make mining a success; partly to
e-action that always follows the "boom" or intense excitement of any busi-
I might also include among these causes the present low prices of metallic
(which I do not think will last much longer) also that during this past winter,
and 1884, we had such general and very deep snows, that in most parts of
State it was impossible to work. Ere that cleared away came the "rich man's
c" in New York City, which sat down upon every uncompleted mining sale,
e proposed buyers did not know how long the trouble would last, and of course,
ood business men, held the cash they had on hand, awaiting the results of the
e. On the heels of this the melting snows caused such freshets that the
oads were washed out, and all means of transportation in some sections for
ime were cut off.

Such facts, following so closely together, would certainly bring the one great
stry of any State to bed rock, and so it is in Colorado.

It would never seem as if bottom had been reached in the latter part of July,
almost at once we hear of work being started universally throughout the State.
marketing of the ore produced, naturally sets money in circulation at once.
only that, but I know that the very men who withdrew from closing pur-
es of mining property at the commencement of the panic, are now coming
ard and taking those same properties, and paying the cash; in some instances
ng more than the price of the previous agreement. Such places as Denver,
blo, and other cities of Colorado, will certainly begin to feel the re-action, or
t of all this for the better, within the next sixty days.

But if your readers will look about for facts, they will be astonished to find
the present yield of Leadville, in gold and silver, for the past six months is
ter than for any six months at the same time of the year in her whole history!
in, so far this year, Gilpin, Clear Creek, and Boulder Counties show every
lence of surpassing any year's product in their whole history as mining coun-
while the whole southern part of the State is now in condition, owing to
elopments, and means of transportation, to make a showing in statistics that
only be expressed by millions. There is no doubt but the change we have
ted and hoped for has actually come, and we can with every confidence look
ard to five years of uninterrupted prosperity, to be closed with a wilder ex-
ment in the mining business than Colorado has yet seen; for when it comes
time, it will not be confined to any one locality or mining section, but be uni-
al throughout the State.

Personally this part is regretted by the writer, as after the "boom" comes
re-action, and business must of course suffer, but human nature is human
re, and I do not see how I can help it.

Respectfully yours, JOHN K. HALLOWELL.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	July 20th to 30th.	Aug. 1st to 10th.	Aug. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min.	66.	51.	62.	59.7
Max	95.	80.	92.	89.0
Min. and Max	80.5	65.	77.	74.3
Range.	29.	29.	30.	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	74.8	63.0	69.0	68.9
2 p. m.	86.3	71.9	80.8	79.7
9 p. m.	73.7	64.5	71.5	69.9
Mean.	77.4	66.0	73.2	72.1
RELATIVE HUMIDITY.				
7 a. m.	.78	.75	.84	.79
2 p. m.	.63	.39	.57	.53
9 p. m.	.80	.75	.86	.80
Mean	.75	.63	.72	.71
PRESSURE AS OBSERVED.				
7 a. m.	28.978	29.167	29.031	29.055
2 p. m.	28.991	29.137	29.011	29.046
9 p. m.	28.901	29.176	29.006	29.028
Mean	28.993	29.160	29.016	29.043
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles	2878	2142	2675	7695
CLOUDING BY TENTHS.				
7 a. m.	3.3	2.7	7.0	4.3
2 p. m.	3.9	1.2	4.3	3.1
9 p. m.	3.2	1.2	5.5	3.3
RAIN.				
Inches.	0.86	.00	3.46	4.32

While July was a warm, moist month, the last decade, which belongs to this report was somewhat less rainy than the earlier part, and this was followed by ten days, from the first of August, in which there was no rain except a sprinkle on the 2d. By this time the ground had become quite parched and fears were entertained lest the corn might suffer. A change, however, occurred on the 11th and in the next ten days eight were rainy and a total 3.46 in. of water fell.

As will be seen in the tabular summary the first decade of August was not only dry but cool. From the 4th to the 9th the temperature fell each day below 60°, and on the 4th and 7th it was 51°.

DIRECT AND INDIRECT BAROMETRIC WAVES.

C. A. SHAW, ERIE, PA.

The barometric disturbance which accompanied the volcanic eruption of the island of Krakatau August 27, 1883, seems to deserve and doubtless will receive exceptional consideration from meteorologists.

Briefly, the narrative is that early in the morning of this date there occurred a gigantic explosion, heard for a long distance, which tore the island apart, threw an immense fragment a distance of some seven miles, probably producing a new island, and started an immense tidal movement which is believed to have journeyed around the world four times. "While the tidal gauges have recorded their story the delicate fingers of the barometrical registers of the world have also borne uninfluenced testimony of a similar kind. The blow which hurled such a mass of matter into the air, which originated a hurricane there and caused the barometers in the neighborhood of the volcano to rise and fall with unparalleled rapidity, and a vessel, distant three hundred miles, to tremble, started an atmospheric wave also around the globe. It was first detected in the Kew registers, and the dates at which the atmospheric undulations passed various places on the earth's surface it has been able to fix in many cases."

"Two waves, one to the east and one to the west, started from Krakatau, *whose rate of progress has been found to be that of sound.*"

The point to which I wish to call attention is that contained in these last words, which I have italicized. It gives the first standard of measurement so far as I am aware, of the rate of speed that a barometric wave travels under normal conditions. Other observations have shown such variable speeds that we must conclude either that their method of progression, as well as of occasion, is decidedly different from normal waves of propulsion or else that it requires an exceptional size of such air-wave to accomplish a rate of progress which shall be uniform and comparable to a standard, as that of the movement of sound.

The barometer, it is said, rose and fell many tenths of an inch in a minute. The rapidity of oscillation is possibly in this case as important as the range, for it implies the power of the impulse to overcome the resisting medium in front and the vibratory action of the surrounding atmosphere in quickly seeking to restore its equilibrium.

Future comparison of meteoric registers will determine several important relations of a local and general character. For example, at that rate of speed it undoubtedly overtook and passed certain areas of atmospheric low and high barometer producing conflicts of a peculiarly interesting nature. Some places must have shown surprising barometric registering, though by the present detached method of making observations it is but by chance that records of the Signal Service at any station would show it. Self-registering instruments are needed.

Were the service under any other direction than that of military men, it

would be pleasing for a scientific inquirer to seek to trace this curious air-wave around the world. But if he should write to the chief office very little satisfaction could be obtained even if he gained permission to write himself personally to each of the observers asking for data. No doubt the weather-bureau is a splendid institution and if it don't hit the weather quite right at the place where the reader chances to be, yet other cities are more favored we will believe. Then it is educating a fine lot of men to be soldiers, and if they do not know much of meteorology that is no disadvantage since out of the service meteorology is not a thing any one can live by.

Scientific men are decided as to the true method of predicting the track of barometric depressions. An example like this of a real wave of unexceptional magnitude which left its mark so definitely that no natural variation could obscure it, is like a case where a natural philosopher has in his own hands an experiment which can prove or disprove a world-accepted theory. At present the best theories of meteorological action have not received the certain sanction of undoubted fact. Ferrel's analysis, mathematical and profound, prove just this, that if true only one man in a million can understand and apply it, only one man in a million be a capable meteorologist. Certainly no army officer. Decidedly no enlisted man qualified and honored that he allows himself to be absorbed by trifling details and never rises to the grasp of principles. In military code all things are equally criminal as betokening insubordination. A hole in the end of a glove, or an ink-spot on a form go down with equal merit of punishment as shooting a comrade or missing an observation.

But it would be cruel while General Hazen is hanging on to his position with toe-nails and eye-lashes to say anything derogatory of his service when every other foreign nation admits that the military organization is the only possible one for efficient action. And this will be shown when the book shortly to be published, upon this very volcanic air-wave shall be made public; materials for which are now being collected by one of the lieutenants detailed for that service. Parodying the old parody of "bring forth the cheese knife," we may cry "bring forth a natural barometric wave (east moving) that can make 18,000 miles in twenty-four hours," and prove that low barometers have any real existence at all.

BOOK NOTICES.

E OF LISZT: By Louis Nohl, translated from the German by Geo. P. Upton. 12mo., pp. 197. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson, $1.25.

This is the fifth of the series of Biographies of Musicians published by this well-known house. The preceding volumes are the lives of Mozart, Beethoven, Iaydn, and Wagner, all of which were well received by the public.

The present volume is rather an essay upon the personal and musical characteristics of Liszt than a biography of him. Dr. Nohl in this sketch seems to have been somewhat carried away by his enthusiastic admiration for the man, who also inspired the same feeling in all his friends and intimates. This feeling manifests itself even in the very preface of the book where the author speaks of his early youth "with its incomperchenoible virtuosity. It is the actual strangling of the serpents in the cradle, so utterly does this power defy every obstacle and difficulty in the revelation of its art." "And now the great man rises resplendent in the great artist, in strong contrast with a kindred genius, the great violinist Paganini in whom, so different from Liszt himself, the essential principle which lies at the very root of artistic creation, namely, the genius of humanity, was not apparent." "Still further, there appears in its wonderful versatility, his active sympathy with all the momentous intellectual questions of the time and of humanity." "Then follows the new epoch in art-development, the creation of the symphonic poem, growing as it were spontaneously out of his association with all that is comprised in poetry and life. Then comes the crown of all, the latest and grandest work he has accomplished, the renovation of church music." These are samples of the admiration and reverence expressed by the author for his subject all through the book. It is thoroughly readable and among musicians alone should have a wide circulation.

THE TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS, Vol. IV, No. 3. R. P. Studley & Co., printers, 1884, $2.00.

We find in this volume articles by Profs. G. Seyffarth, F. E. Nipher, A. V. Leonhard, G. C. Broadhead, G. Engelmann, and G. Hambach: also the journal of proceedings and a list of publications donated and received during the years 1881–84. It is well printed and admirably illustrated. On looking over the journal of proceedings it appears that from ten to twelve members is a full attendance, but the character of the articles show that those members are careful investigators and thorough students. The officers for 1884 are Dr. Geo. Engelmann, President, (since deceased); Vice-Presidents, James M. Leete and M. L. Gray; Corresponding Secretary, Prof. H. S. Pritchett; Recording Secretary, Prof. F. E. Nipher; Treasurer, Enno Sander; Librarian, G. Hambach.

NINTH ANNUAL REPORT OF THE RAILROAD COMMISSIONERS OF THE STATE OF MISSOURI, 1883. Octavo, pp. 291.

From this Report, for which we are indebted to Hon. Geo. C. Pratt, we learn that there are now eighty-five main and branch lines of railroad in the State of Missouri, operated by thirty nominally distinct organizations. Of these organizations fifteen actually separate companies operate from seven-tenths of a mile to eighty-one and three quarters each, amounting altogether to 346.82 miles. The other companies operate the remainder of the lines, amounting to 4,268.74 miles.

The gross transportation earnings inside the State amount to $28,754,335, equal to $6,343 per mile of road operated. The total expenses amount to $18,126,911, equal to $3,996 per mile of road and 63 per cent of gross earnings. The net earnings amount to $10,627,424, equal to 2,347 per mile of road and 37 per cent of gross earnings. Some very important questions are discussed, from which we make an important extract in this issue. The report is illustrated with a very good map of the State showing all of its railroads.

POLITICS: By William W. Crane and Bernard Moses, Ph.D. 12mo., pp. 305. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson, $1.

This work is intended by its authors, the latter named of whom is Professor of History and Political Economy in the University of California, as an introduction to the study of comparative constitutional law and will be found a very comprehensive and useful treatise. In it are discussed such topics as the Nation, the Sovereign, the organs of the Sovereign, the force of the Nation, local powers, instinct as a factor of political organization, the political heritage of the British colonies in America, early impulses to national unity in the British colonies, centrifugal and centripetal forces, the makers of constitutional law, the makers of administrative law, the bi-cameral system of the modern legislature, the initiative in legislation, distribution of powers, the conditions and tendency of normal political growth, the tendency of powers in Federal government, the tendency of power in the United States, the tendency of power in some European federations, political parties. All of these are handled in a learned and liberal spirit suited to the spirit of the present day, and the work would make an excellent text book for the more advanced classes in our colleges, as well as a most useful and suggestive hand-book for all persons desirous of obtaining an accurate comprehension of the political (not partisan) status in the United States.

WHAT IS TO BE DONE? By Robert B. Dixon, M. D. 18mo., pp. 67. Lee & Shepard, Boston, 1884. For sale by M. H. Dickinson 50c.

This little hand-book contains many valuable rules and suggestions for the government of parents in rearing their children and will be found of service under almost all conditions of youthful ailments. We find sections devoted to artificial feeding for infants and children, baths, broken bones, croup, diphtheria, scarlet-fever, teething, vaccination, worms, etc., with sensible directions for nursing and diet as well as judicious remedies for the various complaints.

OTHER PUBLICATIONS RECEIVED.

Catalogue of the State Agricultural College of Kansas, 1883–4, Geo. T. Fairchild, A. M., President. A Letter to Scientists and Inventors on the Science of

Justice and their rights of Perpetual Property in their Discoveries and Inventions, by Lysander Spooner, published by Cupples, Upham & Co., Boston, Mass. An Appeal to the People of the United States in behalf of the Great Statue, Liberty Enlightening the World, Wm. Evarts, President of Executive Committee, New York. The *American*, a magazine of Literature, Education and Science, W. J. Bell and W. C. Ransburg, Editors, Valparaiso, Illinois. The Transactions of the Academy of Science of St. Louis, Vol. 4, No. 3, price $2.00. Professional Papers of Signal Service, No. 13, Temperature of the Atmosphere and Earth's Surface, by Wm. Ferrel, Government Printing Office, Washington, D. C., 1884. The *Young Mineralogist and Antiquarian*, published monthly by G. H. Wise, Wheaton, Illinois, 75 cents per year, Vol. 1, No. 1. Johns Hopkins University Studies, Herbert B. Adams, Editor, Second Series VII. Institutional Beginnings in a Western State, by Jesse Macy, A. B., Baltimore, Md., July, 1884. Ayer & Sons' Manual, 24th Edition, October, 1883, Ayer's Standard Lists of Publications, Philadelphia, Penn.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

TORNADO-PROOF ROOFING.—The object of this invention is to provide a secure and safe fastening tin and sheet-iron roofing.

To be used especially in sections of country that are subject to the ravages of high winds and tornadoes, and it consists in providing extra fastenings in the form of staples or hooks that are driven through the roofing at the joints thereof into the wood-sheeting and clinched or otherwise fastened upon the under side; this in addition to the usual fastening-anchors and nails.

Any desired number of the fastenings may be applied to a roof according to the nature of the surroundings, and the violence of the prevailing winds.

After the fastenings are attached, the openings through the sheets are securely closed with solder thereby keeping the roof perfectly water-tight. Messrs. Chas. E. Wagner and Henry Flynt, of Kansas City, are the inventors.

HANGING SLIDING-DOORS.—This invention relates to improvements in the manner of hanging and operating inside sliding-doors, and its objects are to dispense with the usual double tracks and lateral guiding rollers for the top of the doors, and to provide improved means for keeping the door in a vertical line while in operation.

It consists in using two independent single piece hangers, having journaled

in their upper extremity, a track-wheel with a circular groove upon its circumference and having fixed in a similar manner beneath the wood track a plain-faced roller which is adapted to prevent any tendency of the door toward tipping and raising the other hanger from the track.

A metal track having a circular or convex head, and a flange, on one side is employed, and it is attached to the wood track by any approved means.

In operation an inside sliding-door is suspended from a single track, faced by a circular threaded track-plate and attached to the timbers of a building in the usual manner.

Under-rollers are journaled within the intermediate fork of the hangers and are adapted by contact with the under side of the said track to keep the door in a longitudinally vertical position.

Lateral movement of the hangers is prevented by means of the annular groove upon the face of the suspending wheels fitting over the convex head of the metal track before mentioned.

There are openings in the top of the door in which the pendant threaded-end of the hangers are fixed. These are suitably protected by metal plates, and by reason of a rectangular opening in the same, the hangers are prevented from turning therein.

The door is guided and held in a vertical position by means of a double-roller guide-plate which is adapted to operate within a groove formed in the floor-end of the door, the said guide-rollers are attached to the floor in such a position that the two centres will be in line with the said groove, but the line of the centres may form an angle with the line of the groove, as in this manner the guide-rollers can be so adjusted to a groove that is larger than the diameter of a single roller, as to avert any room for loose rattling.

This rattling is a common defect in the usual method of guiding the lower end of sliding doors.

The hangers described possess the advantage of being easily applied, as there is no leveling of double tracks, and as the weight of the door is hung directly beneath the centre of the track, there is no side draft, as is the case when one side of a double track settles with the building. This invention was recently patented by Mr. Henry Fleming, of this city.

Improved Label-Case for Druggists.—There is provided, a cabinet of suitable capacity and of ornamental construction that is provided with small open-faced compartments in which the labels are placed and held with their upper edges inclined outward, by means of a spring follower.

The case is constructed of any suitable material, preferably wood, and is formed with a number of horizontal rows of compartments that are composed of a back and a top and bottom beveled at the front edge for guiding the upper edges of the label toward the front opening and a facing block that has a segment of its upper edge cnt away so as to exhibit the labels that are contained in the compartment and pressed against the inclined inner-side of the face-block.

The described spring and follower when in use, tend to press the labels outwardly and upwardly so that their upper edges project quite or nearly out of the front opening. This improvement has been patented by Mr. Boyd Keith, of Kansas City.

LOST ARTS IN THE PATENT OFFICE.

W. R. KIRK.

It is not the intention to inquire into the lost arts or the obscure theories of the past, but rather to consider the practical relation of Patent Laws to those arts that have fallen into neglect and been abandoned by reason of the defects in these laws. That such laws offer great encouragement to the development of the arts needs no proof in the midst of the great changes that are taking place. It has been conclusively proven that nations which do not recognize property-right in inventions not only fail to bring to light the theories of their own inventors, but cannot successfully adopt the perfected improvement of other nations. A patent is a contract between the government and the individual in which the interest of the public is as much of an object as the personal rights of the inventor. The government stipulates before granting a patent that the applicant shall make a full and free description of the improvement, so that it will enable any one skilled in the arts to construct the same, and in consideration of this it guarantees to him the exclusive right for a limited time.

It is presumed that the assurance of absolute control for this stated time will be a sufficient incentive for him to overcome the mechanical difficulties and educate the public to a sense of its value. This is the object and the ordinary working of Patent Laws, but there are times when events do not flow in the channels marked out for them: it is this feature that will be considered. The ultimate gain it will confer upon society is the prime factor in granting patents, for if it was held that progress was fatal to society no maudlin sentiment of personal rights would justify such protection. If this view of the proposition be true, are there not times when the courts are bound to follow rules in direct opposition to it? In illustration of this: some one applies for a patent. It may be that he caught the idea from some antiquated relic or he may have reasoned it out from his own stand-point, but when he applies for a patent he is referred to some previous one or some other evidence that some one has discovered it, although it may never have been worked to a successful issue.

The law, while assuming that individual control was necessary to develop inventions, in the absence of the original inventor, decrees that they must be left to their own fate. The first inventor may have been in advance of his time or he might not have appreciated its value. In that event it is not credited to him. If the law was designed only to reward the original inventor it would have accomplished about all that could reasonably be expected of it, but are there not

many times when there are circumstances beyond the control of inventors which render it impossible for them to succeed? One would at first suppose all that was necessary to develop anything new would be to publish it to the world, then the practical man would comprehend its value, and speed him on his way to success; but the history of almost every valuable improvement can be offered as a striking illustration of the falsity of such a theory. Inventions that are now worth many millions went begging for purchasers a few years ago at a mere nominal price. If such inventions have to struggle for existence, is it not reasonable to suppose that all did not get over the dead point, consequently that there are many valuable ideas that are undeveloped and cannot be because they are common property, no one having any special interest in them. The present law is a safe and conservative one and is well calculated to protect the inventor if he is the original one. When the law was framed there was little cause of apprehension concerning lost ideas, as there was a limited assortment with which to distract public attention.

Any change recognizing this feature should be approached with great caution, as it would open a convenient way to the greatest injustice. In many cases it would be difficult to tell when an art had passed into this neglected state, for in some instances a few machines would be sufficient to supply all wants, but if there was any doubt, patents need not be issued. Questions of as much importance are constantly arising under the present law. It would probably be wise to allow a considerable lapse of time from first evidence, or when patents had been granted they certainly should be allowed to expire, although they are frequently bought with no intention of developing them. This happens when parties do not wish the trouble of a change and do not like to run the risk of competition. The tendencies of patentees to sit down, as it were, on their inventions was brought up in a late Congress as a plea to invade the exclusive right. The argument was set forward on the part of certain corporations which would be the first to avail themselves of such a privilege, but they could afford to part with this one when they had secured a greater advantage. It is evident that the right to be effective must be absolute throughout the term of the grant. The philosophy that would regulate one's business is closely associated with communism and makes all ventures uncertain, yet there seems to be no good reason why such theories may not again be revived when the patents expire, for it is certainly a perversion of the spirit and intent of the law.

Seeing with what adverse circumstances inventions labor in unfavorable times, private misfortunes, public lethargy, unmitigated selfishness, it is not surprising that some should fail of being developed. In case prior invention is the difficulty met with, the problem is frequently complicated from the fact that the idea is not only absolute but of foreign origin and may never before have been known in one's own country, yet the court is governed by the theory that the public has gained by the investigation and that the matter must still remain in obscurity or else take care of itself. Whatever may be said, the present Patent Law is a good one and all such changes are attended with danger, and if we view

the hostile action of the last Congress, the friends of progress will be thankful if they can keep it as it is. An eminent jurist introduced a Bill into Congress during the last term, providing that innocence should be a valid defense for the infringement of this the most intangible of all rights. It was also suggested that the infringer should remain in the undisturbed possession of the right if it was for his own use. They would have to pay the customary fee. This would be a very convenient arrangement for the corporations that were advancing it, for having established a communism of rights they would have little to fear from the average patentee. In nearly all the cases cited in support of these attacks, had the infringers been made to pay the damages, they would still have been benefited by their use. The number of hardships are marvelously few, when we consider what great changes have taken place in late years, and in many of these so-called hardships the infringer did not use the most ordinary precaution. Certainly there are but very few of them who have not received as much benefit as injury f.om modern improvement.

Just here it might be well to consider the great amount of trouble caused by a litigation that arises out of the common and best established law-rights. Yet these few exceptions are taken up and made the grounds for legislation that would compromise the whole system. Whatever may be said upon the question, the remedies they suggest have the merits of completeness, and should they become laws they could have but little more to ask.

THE TWILIGHT OF GREEK AND ROMAN SCULPTURE.

WILLIAM SHIELDS LISCOMB.

It seems surprising, not that so many works of ancient art have been destroyed, but that any at all have remained until the present day. Transported from place to place, shattered by accidents, overthrown by earthquakes, consumed by conflagrations, subject to the destructive malice of Macedonian and Roman emperors, exposed to the violence of wars, buried beneath falling walls; delivered to the axe of the inconoclast, the hammer of the mason, the kiln of the lime-maker, and the melting-furnace of the bronze-moulder; torn from their bases, trampled in the mire and filth of the streets, broken into fragments, and gradually overwhelmed and hidden from view beneath the earth, how slight was the chance that productions of the golden age of Athenian sculpture should ever meet the eyes of that far-off nineteenth century in which we have our being! With what reverence may we justly stand before a work which, surviving such vicissitudes, has traversed the vast reaches of bleak, barren centuries that lie between us and antiquity, to greet us with its matchless loveliness to-day! Perikles may have gazed upon it; Sokrates, Plato, Aristotle, and Zeno may have taught their disciples in its presence; Euripides and Sophokles may have paused in the composition of their stately lines to rest the eye and brain on the symmetry of its propor-

tions and the spotless purity of its marble; Herodotus may have recited his histories and Demosthenes have thundered his eloquence before it; Cicero may have turned aside from the delights of poetry and the comforts of philosophy to contemplate in it the evidence of a finer genius than his countrymen could ever hope to attain; Virgil, Horace, and Ovid may have found their perceptions of beauty elevated and made nobler by its influence; the glance of Paul may have wandered over it as he proclaimed to the people the mysteries of the new birth and the hope of the resurrection; Marcus Aurelius may have seen in it a reflection of that heavenly truth and harmony in which his lofty soul found consolation; and still to-day the connoisseur may dwell upon it with ever-increasing delight, and find the subtle sympathy of art lifting him closer and closer into communion with those master souls of the past,—

> "The dead but sceptred sovereigns, who still rule
> Our spirits from their urns."

—*August Atlantic.*

EDITORIAL NOTES.

At 2:05 on Sunday the 10th ult., a sharp earthquake shock was felt in New York, Pennsylvania, and the New England States. As the observatory of the United States Signal Service, in the Equitable building, New York, the time of the earthquake and its duration were noted. Assistant Observers R. E. Hinman and Mervine were at the time in the office, which is on the roof of the building, about 200 feet above the level of the street. The first intimation of the earthquake was a low, rumbling sound, like the mutterings of distant thunder. It was immediately followed by a shock, as that of a violent explosion, which caused the building to quiver, although it did not shake perceptibly. The rattling continued for about eight seconds, and was accompanied by the rumbling sound, which gradually died away. The first shock was felt at about 2:11. The effect of the jar was much more perceptible in houses of light structure. While the shock was felt strongly in the dwelling houses, it is somewhat singular that persons traveling on the elevated roads did not know of the occurrence until they were told of it by people getting in at the stations, and that the shock felt in the elevated stations was slight compared with that felt on the ground below. As far as can be ascertained the shock was entirely imperceptible on the water, and no wave such as usually accompanies the phenomena in the adjacent waters was here observed.

Among other favorable notices of the article on the "Sewerage of Kansas City," by Mr. G. W. Pearsons, in the August Review, we find the following in a personal letter from the celebrated engineer, G. E. Waring, Esq.: "I have read with great pleasure your article in the Kansas City Review. You put the thing in a nutshell, so far as K. C. is concerned, and, indeed, strike what is likely to be the general compromise for all larger cities, it is precisely this that they are proposing to do in Paris."

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

WE were much pleased on the 14th ult. to receive a visit from the well-known Quaker-shoemaker-astronomer of Spiceland, Indiana, Professor Wm. Dawson, whose articles have so frequently appeared in the REVIEW during the past five or six years.

THE Interior Department, the Patent Office and the Smithsonian Institution are preparing to make a very fine exhibit at the New Orleans Exposition this winter, also for those at Cincinnati and Louisville this fall. Several car loads have already been shipped and others are nearly ready.

THE Kansas State Historical Society has accepted an invitation to coöperate with the Kansas Old Settlers' Association in a celebration at Bismarck Grove, Lawrence, of the thirtieth anniversary of the settlement of Kansas. The celebration will take place on September 3, 1884. Hon. F. P. Baker, President of the Historical Society, will deliver an address on the subject of "The Uses and Value of Historical Societies." The meeting is intended to be a general gathering of the early settlers of Kansas, and of all interested in the stirring events of the period of early settlement. The Kansas Territorial ex-Governors, Denver and Stanton, General John A. Logan, and others from abroad, have accepted invitations to be present.

THE Catalogue of the Missouri State University for 1883-4 shows an attendance, in all the departments, of 573 from seventy-seven counties of Missouri and seventeen other States and Territories. The Academic course of study is very complete; it extends over six years and is adapted to the educational wants of the State. There is no preparatory department but each one of the associated schools provides instruction in its own line of work to meet the need arising out of the lack of an adequate supply of High Schools. The optional feature is given free play under certain restrictions. Students, male or female, are allowed to enter any classes for which, on examination, they are found qualified; but each student must have in hand a certain number of hours of study and recitation for each week. Certificates are given by the Faculty certifying to the amount of work done by any student, and standing in the same; but all Degrees, attested by the Diploma of the Curators, are given only on the completion in detail of prescribed courses. The reputation of the University, as comparing favorably with our best institutions, seems to have been earned by the honest hard work of its industrious faculty. The next session begins September 8, 1884.

SIR JOHN LUBBOCK, the banker, parliamentarian and scientist, who owes his chief fame to his wonderfully minute researches in entomology, has been compelled to forego his visit to Montreal to meet his fellow members of the Royal Society, by reason of a severe attack of the gout. His absence will be regretted equally by his admirers among the members of the American Association.

MR. E. R. KNOWLES, who has written several reliable articles for the REVIEW within the past three years, and who is now connected with the Providence *Journal*, after investigating the manifestations of Miss Lulu Hurst, is convinced that "her manifestations are all simply the exertion of muscular strength under certain most favorable conditions by a young lady of fine physical development, and exceedingly skillful in applying her strength, and in knowing how to avail herself of any possible contingency of position, weight, embarrassment, hesitation, or confusion afforded by those who test her power; and that, governed by the same conditions, any person of equal physical strength can produce exactly the same phenomena with no more apparent effort. These feats are entirely physical, and can be confounded

with the phenomena of etheropathic induction only by the same class of persons who are easily led to believe in spiritualism merely by the cabinet mysteries and other very skillful feats of clever operators."

Few people are aware of the important work now under way in Northern Minnesota, to guard against the dangers of high water and the inconveniences of low water in the Mississippi River. A number of lakes in that region are being connected into a reservoir system, which is to collect and feed water as it may be required. A full account of this great engineering work is promised, with illustrative diagrams, in the September *Harper's Monthly*.

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PROCEEDINGS OF SOCIETIES.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—PHILADELPHIA MEETING.

REPORTED BY PROF. E. H. S. BAILEY.

The general sessions of the Association were held in the Academy of Music. Thursday was largely spent in the usual routine work of organization. In the evening Prof. Newberry, of Columbia College, delivered an illustrated lecture upon the subject, "The Geological Evolution of the North American Continent." At the general session on Friday morning the subject of an Inter-National Scientific Congress was thoroughly discussed. Both British and American scientists strongly favor the movement. In the evening the citizens of Philadelphia tendered a reception to the members of the British and American Associations. Hon. John Welsh, of Philadelphia, delivered an address of welcome, followed by Dr. Pepper, of the University of Pennsylvania. Prof. Young, of Princeton College, the retiring President of the American Association, read the annual address upon "The Pending Problem of Astronomy." The subject was discussed in his well known masterly manner. Dr. Ball, of Ireland, being called upon responded in a three minute speech, winning the good opinion of the audience. The remainder of the evening was devoted to an informal promenade and partaking of the generous lunch provided.

On Saturday, there being no session of the Association, the members were at liberty to join any of the excursions given by different railroad companies.

Many went to Long Branch where a reception was tendered them by Past-President Isaac Lea; others went to Atlantic City, and others to Cape May, where they were entertained at Congress Hall. Many, especially of the foreign members, visited the anthracite coal regions, while the botanists visited the pine barrens of New Jersey.

On Monday morning at the general session reports were read from a number of special committes. After work during the day in the special sections, the members in the afternoon and evening visited the Zoölogical Gardens, the reception at the Woman's Medical College and that tendered by the Faculty of the University of Pennsylvania.

Professor Robert S. Ball delivered a thoroughly scientific lecture on Tuesday evening upon "The Distance of the Stars." A reception given at the Pennsylvania Academy of Fine Arts followed the lecture. This really artistic building was beautifully decorated with flowers and vines, and the reception was perhaps he most brilliant of the session.

Wednesday afternoon was devoted to a reception at Haverford College, and on Thursday evening the exercises closed. The meeting was of particular interest on account of the presence of so many distinguished foreigners. Several other scientific societies met in the city at the same time. Over 1,200 members were present, and nearly 500 new members were elected.

The following officers were elected for next year:

President.—Prof. H. A. Newton, of Yale.

Vice-Presidents.—Section A—J. M. Van Vleck, Middletown, Conn. Section B—Professor C. F. Brackett, Princeton College. Section C—William R. Nichols, Boston. Section D—Professor J. Burkitt Webb, Cambridge. Section E—Professor Edward Orton, Columbus, O. Section F—Professor B. G. Wilder, Cornell University. Section G—Professor S. H. Gage, Cornell University. Section H—Professor William H. Dall, Washington. Section I—Professor Edward Atkins, Boston.

Permanent Secretary.—Professor F. W. Putnam, Cambridge (re-elected).

General Secretary.—Charles Sedgwick Minot, Boston.

Assistant General Secretary.—C. C. Abbott, Trenton.

Secretaries of the Sections.—A—E. W. Hyde, Cincinnati. B—Professor A. A. Michelson, Cleveland. C—Professor F. P. Dunnington, University of Virginia. D—C. J. H. Woodbury, Boston. E—Professor H. Carvill Lewis, Philadelphia. F—M. C. Fernald, Maine. G—W. H. Walmsley, Philadelphia. H—Mrs. Erminnie A. Smith, New Jersey. I—J. W. Chickering, Washington.

The next meeting will be held in Bar Harbor, Maine, or Ann Arbor, Mich.

The following are the titles of some of the papers read:

Section A (Mathematics and Astronomy) met in Room 1, Horticultural Hall. Vice-President H. T. Eddy, of Cincinnati, was in the chair, and G. W. Hough, of Chicago, acted as secretary. The papers presented, as was the case in all the sections, were not all read, there not being sufficient time. Following is a list of e papers:

Results of observation and experiment with an "Almacantar" of four inches aperture, at the Harvard College, S. C. Chandler, Jr. On the colors of variable stars, S. C. Chandler, Jr. Colors of the stars, E. C. Pickering. Temporary stars, Daniel Kirkwood. A criterion for the rejection of doubtful observations, Mansfield Merriman. On the magnitude of the errors which may be introduced in the reduction of an observed system of stellar co-ordinates to an assumed normal system by graphic methods, William A. Rogers. Systematic errors in stellar magnitudes, E. C. Pickering. The average asteroid orbit and the asteroid ring, M. W. Harrington. On the original graduation of the Harvard College meridian circle, *in situ*, William A. Rogers and George A. Clark. To exhibit and describe a model of the ruled cubic surface known as the cylindroid, Robert S. Ball. The geodetic work of the United States Coast and Geodetic Survey, J. Howard Gore. The lunar aurora, John Haywood. Micrometric observations of Jupiter's third satellite, David P. Todd. On the course of the corrections to the heliocentric longitudes of Newcomb's tables of Uranus and Neptune, David P. Todd. Mechanical arithmetic illustrated by the averaging machine, W. S. Auchincloss. Analysis of the formula for the Moon's latitude as effected by the figure of the Earth, John N. Stockwell. The products of vectors, Samuel Emerson. On an indirect solution of the equation $a = ac + \frac{d_a}{dt} + \frac{1\, d^2_a\, t^2}{2\, dt^2} + \frac{1}{2} - 3 \frac{d^3_a\, t^3}{d_{,3}}$ ac. to the sixth power of the time, in which $\frac{d_a}{dt}$ is a function of four variables, William A. Rogers. Description of the Leander McCormick observatory of the University of Virginia, Ormond Stone. On the visibility of faint objects under red illumination, G. W. Hough. A brief account of some preliminary experiments in the construction of clocks of precision, Leonard Waldo. A collection of formulæ for the area of a plane triangle, Marcus Baker. The nebulæ, Lewis Swift. On the fundamental formula of statistical mechanics, with applications to astronomy and thermo-dynamics, J. Willard Gibbs. On the rotation of a rigid system in four-dimensional space, Irving Stringham. A geometrical interpretation of the linear bi-lateral quaternion equation, Irving Stringham. A new apparatus for the study of Bayle's law, Leroy C. Cooley. On the mean temperature of the two hemispheres of the earth, H. Hennessy. On the constitution of the earth and planets, H. Hennessy. On an international standard for measurements, H. Hennessy. Linear functions of points, lines and planes, E. W. Hyde. Late researches on the solar surface with special reference to evanescent spots, S. J. Perry. Harmonic motion in stellar systems, Pliny Earle Chase.

Section B (Physics) assembled in the chapel of the Episcopal Academy. John Trowbridge, of Cambridge, Mass., acted as chairman and N. D. C. Hodges, of Salem, Mass., as secretary. The papers presented were:

On the Fritts' selenium cells and batteries, Charles E. Fritts. Relation of the electromotive force of a Daniell cell and the strength of the zinc sulphate solution, H. S. Carhart. Note on the periodic modification of electrostatic in-

duction, H. S. Carhart. Description of a Galvanometer for demonstrating the internal current transmitted through the liquid within a Voltaic cell, Conrad W. Cooke. On the variation of the resistance of Carbon under pressure, T. C. Mendenhall. Determination of the co-efficient of the speculum metal used for Professor Rolan's grating, William A. Rogers. Additional observations confirming the relation: Metre des archives=Imperial yard plus 3.37027 inches, William A. Rogers. A spectrophotometric study of pigments, Edward L. Nicolls. On the sensitiveness of the eye to colors of a low degree of saturation, Edward L. Nicolls. Sensitiveness of photographic dry plates, William H. Pickering. Photography of the infra-red region of the spectrum, William H. Pickering. Method for practical examination of railway employees as to color-blindness, acuteness of vision and hearing; with the results obtained by it, on the Pennsylvania Railroad, William Thomson. Upon a generator in use at Cornell University for producing oxygen and hydrogen gas by means of the dynamo machine, William A. Anthony. Thunderstorms and their relations to "low," Henry A. Hazen. A method of distributing weather forecasts by means of railroad trans, etc., John A. Miller. Thermal belts, J. W. Chickering, Jr. Notes on aneroids, M. W. Harrington. Some relations of positive and negative electricity, H. W. Eaton. On the magnetic rotation of the equipotential lines of electric currents in various metals and alloys, Edwin H. Hall. A proposed method of determining the magnetic dip by means of a magnetic pendulum, Marcus Baker. A possible method of electrical communication between vessels at sea, A. Graham Bell. Description of a galvanometer for demonstrating the internal current transmitted through the liquid within a voltaic cell, Conrad W. Cooke. An absolute Sensitomer, G. W. Hough. Notes on acoustics, Charles R. Cross. On a proposed method of ascertaining the least number of vibrations necessary to determine pitch, Charles R. Cross. On the formulæ for spherical refraction and thick lenses, James Loudon. On the distribution of potential in conductors experiencing the electromagnetic effects discovered by Hall, Sir William Thomson. On a standard galvanometer, S. P. Thompson. On the government of electric motors, S. P. Thompson. A preliminary note on the action of acids upon iron in the magnetic field, E. L. Nicolls. On a proof contact theory of electricity, A. E. Dolbear. On comparative cost electric light and oxy-calcium light, A. E. Dolbear. Electric discharges in relation to the equilibrium of gaseous atmosphere, James Dewar. First steps toward a general system of observations of atmospheric electricity, C. Abbe. Organization of seismological observations, C. Abbe. Methods of varifying weather probabilities, C. Abbe. Standards of barometry and thermometry, C. Abbe. The Princeton Meteorological Observatory, Wm. Libbey, Jr. Local and topical weather cards, W. M. Davis. Change in rainfall of Virginia, J. R. Purdie. An experiment for illustrating the conversion of mechanical energy into heat, C. E. Monroe. A form of apparatus for determinig the diathermacy of air and gases. R. Paddock. On the intensity of sound: the energy used by an organ pipe, .. K. Wead.

Section C (Chemistry) held its meetings in the chemical lecture-room of the

Episcopal Academy. John W. Langley, of Ann Arbor, Mich., was chairman and Henry Carmichael, of Brunswick, Maine, secretary. A list of the papers is appended:

On chloroproprionic acid and certain substituted acrylic and proprionic acids, C. F. Mabery. Torsion balances, Alfred Springer. Anhydrobenzoamidosalicyclic acid, Charles W. Dabney. Continuous etherification, L. M. Norton and C. O. Prescott. Analysis of a mural efflorescence, C. E. Monroe. The chemistry of roller milling, Clifford Richardson. On the chemistry of fish, W. O. Atwater. Examination of methods proposed for rendering the ligher petroleum oils inexplosive, C. E. Monroe. A new form of gas regulator, F. P. Dunnington. Notes on Remsch's test, Henry Leffmann. Discussion on Valence, to be opened by E. W. Clarke. Modification of Ruffles, method for the absolute determination of nitrogen, H. C. White. Optical method of estimating sugar in milk, H. W. Wiley. A preliminary report on the composition of the coals of Kansas, E. H. S. Bailey. Discussion—Educational methods in laboratory practice and in the illustration of chemical lectures, opened by Ira Remsen. Fermentation without combined nitrogen, Alfred Springer. On the assimilation of atmospheric nitrogen by plants, W. O. Atwater. An explanation of Gladstone and Tribe's "2—3 law in chemical dynamics," John W. Langley. Preliminary analysis of the bark of Fouquieria splendens, Engel, Helen C. De S. Abbott. The density of solid carbonic acid, James Dewar. On a substitute for litmus, John Fred. Heyes. Some observations on the phenomena of deliquescence, C. E. Monroe. Methods of milk analysis, Albert N. Leeds. Simple lecture illustrations, F. P. Dunnington. Production of argentic hydrate, F. P. Dunnington. Improvements in apparatus for rapid gas analysis, Arthur H. Elliott. Anthrocene from water gas tar, Arthur H. Elliott.

Section D (Mechanical Science and Statistics) occupied Room 2, Horticulural Hall, and with R. W. Thurston, of Hoboken, N. J., in the chair, and J. Burkitt Webb, of Ithaca, at the secretary's table, turned its attention to the following:

Steam engine practice in the United States, J. C. Hoadley. The strength of cast iron, W. J. Millar. Three problems of river physics, J. B. Johnson. Topography of machines, Oberlin Smith. Driven wells, J. C. Hoadley. Training for mechanical engineers, George J. Alden. Heating from a central source, Frederick Bramwell. Giant's Causeway and Portrush Electric Railway, W. A. Trail. On a new method of producing screws of standard length and uniform pitch, William A. Rogers. The production of optical surfaces, John A. Brashear. Irregularity in railroad building a chief cause of recent business depressions, William Kent. Electric tramways, M. H. Smith. Economy of the electric light, A. Stirling. Dillon's automatic sounder, Mr. Dillon. Dillon's flood regulator, Mr. Dillon.

Section E (Geology and Geography) held its sessions in the main Horticultural Hall. N. H. Winchell, of Minneapolis, presided, Eugene A. Smith, of

Tuscaloosa, Ala., performing the duties of secretary. The papers handed in were:

The geological age, character and origin of the gypsum beds of Cayuga County, N. Y., S. G. Williams. The correlation of the lower coal measures of Ohio and Eastern Kentucky, Edward Orton. On a section of the strata of cretaceous and tertiary formations of Alabama, Eugene A. Smith and L. C. Johnson. On some fish remains recently discovered in the silurian rocks of Pennsylvania, E. W. Clayple. The horizons of petroleum and inflammable gas in Ohio, Edward Orton. A review of the geology of Delaware, results of a survey now in progress, Frederick D. Chester. The salt-well at Humboldt, Minn., N. H. Winchell. An attempt to determine the amount of chemical erosion taking place in the limestone (calciferous to Trenton) valley of Centre County, Penn., and hence applicable to similar regions throughout the Appalachian system, A. S. Ewing. Deep-sea sounding in the Carribbean Sea, J. R. Bartlett, Navy Department, Washington, D. C. On the relative level of the Atlantic Ocean and Gulf of Mexico, with remarks on the Gulf Stream and deep-sea temperatures, J. E. Hilgard. Recent improvement in apparatus and methods of sounding ocean depths, Daniel Ammon. Notice of a new and important work on the origin of the crystalline schists, by Dr. I. Lehman, George H. Williams. The Second Geological Survey of Pennsylvania, Charles A. Ashburner. A brief account of the remarkable explorations in Thibet, Mongolia and the frontiers of India and China, receptly made by Kreshna, or A. K., a native surveyor, trained under the Trigonometrical Survey of India, with official map, Trelawney Saunders. New identifications in Biblical Geography, based on the recent survey of Western Palestine, made for the Palestine Exploration Fund, with the great map of the survey, and the reduced map of the Old Testament, Apocrypha and Josephus, derived therefrom, Trelawney Saunders. On the intimate relations of the Chemung and Waverly Groups in the northwestern portions of Pennsylvania and southwestern part of New York, James Hall. On the Eurypteridæ of the Devonian and Carboniferous systems of the United States, with a supplementary note on a species of Stylonurus, James Hall. British earthquakes and their seismic relations, Richard Owen. Sketch of life and scientific work of Dr. Arnold Guyot, William Libbey, Jr. Geographic classifications, illustrated by a study of plains, plateaus and their derivatives, W. M. Davis. On the ultimate results of converting the basin of the Desert of Sahara into an inland lake, P. H. Vander Weyde. Note on Cassiterite from King's Mountain, N. C., Charles W. Dabney, Jr. North Carolina phosphates, Charles W. Dabney, Jr. Native antimony from York, Prince William County, N. B., George F. Kunz. A great trap dyke across southeastern Pennsylvania, H. Carvill Lewis. A study of one point in the archæanpalæozoic contact line in southeastern Pennsylvania, Persifor Frazer. Geographical and physical conditions as modifying fossil faunas, H. S. Williams. On some large and peculiar fossil fishes from Ohio and Indiana, J. S. Newberry. On the geological survey of New Jersey, George H. Cook. The profile of Nicaragua, geographical and commercial, Captain Bedford Pim, R. N. The

pilot chart of the North Atlantic Ocean, J. R. Bartlett, Navy Department. Metamosphism in the Huronian of the Northwest, R. D. Irving. Identification of the Green Mountain gneisses in Eastern New England, C. H. Hitchcock. Occurrence of builders of decomposition in gneiss at Washington, D. C., J. W. Spencer. A study of "Eozoon Canadense," Alexis A. Julien. Evidences of local glaciers in the Catskill Mountain region, John C. Smock. Sand boulders in drift at Columbia, Mo., J. W. Spencer. The Missouri coteau and its moraines, J. E. Todd. Course of motion in glaciers, Charles Whittlesey. The genesis and conservation of volcanic enery, J. W. Pike. Exhibition of a geological map of the United States, and a geological map of New York, New Jesery and Pennsylvania, J. W. Powell. On the phpsical condition of the interior of the earth, H. Hennessy. Musical sound, its wide distribution and properties, H. C. Bolton. Musical sand: its wide distribution and properties, H. Carrington Bolton and Alexis A. Julien. Notice on the micoscopical examination of a series of ocean, lake, and desert sands, Alexis A. Julien and H. Carrington Bolton. On the erosive action of the ice, J. S. Newberry.

Section F (Biology) transacted business in the hall of the Union League. E. D. Cope, of Philadelphia, was chairman, and C. E. Bessey, of Ames, Iowa, secretary. The papers were:

On Tenecanthus and Gyracanthus from the Chemung of Pennsylvania, E. W. Claypole. Some observations on the influence of oxygenated and un-oxygenated blood, as well as of blood in various degrees of dilution on the isolated heart of the frog and terrapin, H. G. Beyer. Affinities of Dionæa, Joseph F. James. Biological problems, C. S. Minot. A botanical study of the mite-gall found on the petiole of *Juglans nigra*, known as *Erineum anomalum*: Schw., Lillie J. Martin. The habits of some Arvicolinæ, Edgar R. Quick and A. W. Butler. The existence and dorsal circumscription of the port Æ (foramen and Monro) in the adult human brain, Burt G. Wilder. The relative position of the cerebrum and the cerebellum in anthropoid apes, Burt G. Wilder. Observation on the phylogony of the artiodactyla mammalia, derived from American fossils, E. D. Cope. The torsion of leaves, W. J. Beal. The fossil flora of the globe, historical view, Lester F. Ward. The fossil flora of the globe, geological view, Lester F. Ward. The fossil flora of the globe, botanical view, Lester F. Ward. Influence of isolation upon vegetation, E. Lewis Sturtevant. The osteology of oreodon, W. B. Scott. Vesiculæ seminales of the Guinea pigs, C. S. Minot. A new parasitic Copepode from the clam (Mya arenaria), R. Ramsay Wright. The influence of cross fertilization upon the development of the strawberry, William R. Lazentey. Experimental research relating to the etiology of tuberculosis, George M. Sternberg. On the extinction of species, Thomas Meehan. Preliminary note on the lymphatics of the common bull-head (*Amiurus catus*), F. L. Kilborne and S. H. Gage. On the nervous system of Comatula with observations on the mutual affinities of the recent group of Echinoderms, A. Milnes Marshall. Stomates on seeds, George Macloskie. Structure and development of suspensory ligament in the horse, ox and sheep, D. J. Cunningham. Ethidene dichloride as an anæs-

thic, John G. McKendrick. On the hitherto unknown mode of oviposition in the Carabidæ, C. V. Riley. Preliminary notes on the delicacy of the special senses, E. H. S. Bailey and E. L. Nichols. The adventitious inflorescence of curcuta glomerata, C. E. Bessey. On a special function of the external third of the lenticular nucleus of the corpus striatum, Charles Porter Hart. Observations upon the amphibia brain, from a comparison of amphiuma, menopoma, menobranchus, Henry F. Osborne. Fertility in hybridization, R. B. Roosevelt. On tbe skin of insect, C. S. Minot. Hibernation of the lower vertebrates, A. W. Butler. The develoyment of limulus, J. S. Kingsley. Do the cerebellum and oblongata represent two encephalic segments or only one? Burt G. Wilder. On the morphology and evolution of the tail of osseous fishes, John A. Ryder. On the mammalian affinities of the saurians of the Peruvian epoch, Edward D. Cope. The hood of the hooded seal (Cystophora cristata), C. Hart Merriam. Remarks of delegates from the *Ornithologischer verein in Wein*, C. Hart Merriam. Polarity of leaves of Erigeron Canadense, W. J. Beal. On some points in the development of pelagic teleostean eggs, George Brook, Jr. The dynamics of the insect crust, George Macloskie. Some questions in anatomical nomenclature, Burt G. Wilder. Experimental researches on the so-called thought transference, L. F. Barrett. Alleged sensory effects of magnetism, L. F. Barrett. On the finger-muscles in *Megaptera longimana*, and other whales, John Struthers. On the presence of eyes and other sense organs on the shells of chitonidæ, H. N. Moseley. Utricularia vulgarus with young teleostean fishes entrapped in the bladder-traps of that plant, H. N. Moseley. Feathers of the Dodo, H. N. Moseley. Larval theory of the origin of tissue, Alpheus Hyatt. Objections to some commonly accepted views of heredity, Alpheus Hyatt. Structure and affinities of Beatricea, Alpheus Hyatt. Structure of the siphon in the Endoceratidæ, Alpheus Hyatt. Researches on growth and death, Charles S. Minot.

Section G (Histology and Microscopy) spent the day in the hall of the College of Physicians. T. G. Wormley, of Philadelphia, presided and Romyn Hitchcock, of New York City, acted as secretary. Following are the papers:

Methods of cultivating micro-organisms, George M. Sternberg. Remarks on fluid and gelatinous media for cultivating micro-organisms, with description of Salmon's new culture tube and demonstration of the method of using it, R. Hitchcock. On the reproduction of short standards of length, William A. Rogers. On some new microscopic devices, R. H. Ward. Recent studies on the theory of the microscope, and their practical results as regards the use of the microscope in scientific investigations, R. Hitchcock. On some points in microtomy, John A. Ryder. Upon a microscopic method of studying the amphibian brain, Henry F. Osborne. Histology of Lingula, H. G. Beyer. Description of the Schroder camera lucida, R. Hitchcock. Demonstrations of perforations in the cellulose walls of plant-cells, Louis Elsberg. Electric illumination for microscope, with practical illustration, W. H. Walmsley. Celloidine as an imbedding mass, Wm. Libbey, Jr. An immersion apparatus for the determination of the temperature of the critical point in the fluid cavities of minerals, A. A. Julien.

Section H (Anthropology) was called to order in the Foyer of the Academy of Music. E. S. Morse, of Salem, Mass., was chairman, and G. H. Perkins, of Burlington, secretary. The following papers were received:

Uses of the emblematic mounds, Stephen D. Peet. The lineal measures of the semi-civililized nations, D. G. Brinton. The sacred pipes of friendship, Frank La Flesche. Some observations upon the usage, symbolism and influence of the sacred pipes of fellowship among the Omahas, Alice C. Fletcher. Notes upon some quartz objects from Central Minnesota, Miss F. E. Babbitt. The importance of the study of primitive architecture to an understanding of the prehistoric age in America, Stephen D. Peet. Local weather lore, Amos W. Butler. Some characteristics of the Indian earth and shell-mounds on the Atlantic Coast of Florida, Andrew E. Douglass. The manner in which Indians made their stone implements, P. R. Hoy. Disputed points concerning Iroquois pronouns, Erminnie A. Smith. Remarks on North American races and civilization, E. B. Tylor. Upon the evolution of a race of deaf mutes in America, A. Graham Bell. The occurrence of man in the upper miocene of Nebraska, E. D. Cope. The use of the plough in Japan, Edward S. Morse. The three culture periods, J. W. Powell. A search in British North America for lost colonies of Northmen and Portuguese, D. G. Haliburton. The sacrificial stone of San Juan Teotihuacan, A. W. Butler. Eastern archery, Edward S. Morse. Formation of Iroquois words, Erminnie A. Smith. The different races who built mounds in Wisconsin, Stephen D. Peet. Evolution of animal life illustrated by study of emblematic mounds, Stephen D. Peet. Etymology of the Iroquois word Rha-wen-ni-yu, Erminnie A. Smith. Description of the skeletons and skulls found in the large mound of the Turner Loup, Ohio, Cordelia A. Studley. Mythology of the Wintuns, J. W. Powell. Interviews with a Korean, Edward S. Morse. Some parallelism in the evolution of races in the old and new world, Daniel Wilson. On the geographical distribution of labretifery, W. H. Dall. On the identification of the animals and plants of India which are mentioned by ancient Greek authors, V. Ball. The comparative longevity of the sexes, Mrs. A. B. Blackwell.

Section I (Economic Science and Statistics) was quartered in the hall of the the Historical Society, with John Eaton and C. W. Smiley, of Washington, D. C., as chairman and secretary respectively. The papers were:

The principles of graphic illustration, Franklin B. Hough. On the credit of the United States Government, E. B Elliott. The future of the United States, John Biddulph Martin. The structure and economic value of some of our woods (Illustrated), P. H. Dudley. Some experiments in a new method of land cultivation by the use of dynamite and the important results obtained, George W. Holley. The apprenticeship question and industrial schools, Thomas Hampson. Lands in severalty to Indians, illustrated by experiences with the Omaha tribe, Alice C. Fletcher. Condition of deaf mutes and deaf mute instruction in the United States, statistically considered, J. W. Chickering, Jr. Production and distribution, Edward Atkinson. Upon the expediency of a proposed "new departure" in the form of schools for the education of deaf mutes, Joseph C. Gor-

don. On indexing the literature of science, B. Pickman Mann. Percentages and costs of nutrients in foods, W. O. Atwater. Brief outlines of the investigations upon the power to move railroad trains and the mechanical inspection of railroad tracks, as made by the dynagraph and track inspection car, P. H. Dudley. Irregularity in railroad building a chief cause of recent business depressions, William Kent. An account of the first general census of India, Trelawney Saunders. The uses of great expositions, Lyndon A. Smith. American production for American consumption, J. R. Dodge. A review of the proceedings of the section of economic science and statistics at the Montreal meeting, B. A. A. S., Chas. W. Smiley. Commercial relations of the United States with Spain and her colonies, his Excellency Don Arturo de Marcoartu. The American pearl, George F. Kunz. The philosophy of criminal development, Lewis W. Haupt. An illustration of the results produced by the artificial propagation of fish, Chas. W. Smiley. The education of pauper children, industrially and otherwise, James O. Bevan. On technical education in the British Islands, Henry Hennessy. Natural scheme of high culture in the United States of America, Knut Forsberg. The learned professions and the public, 1870—1880, Chas. Warren. The aims and methods of manual training-schools, C. M. Woodward. On the application of the historical method to questions in economic science, T. B. Browning. A new resource for the women of the United States—silk culture, Loren Blodget. Some economic and social effects of machinery, Edward T. Peters. A discussion of the principles involved in the general action of vegetation and of trees especially to prevent extremes of temperature, James Hyatt. National identity in its economic aspect, Loren Blodgett.

THE BRITISH ASSOCIATION AT MONTREAL.

On August 27th the British Association for the Advancement of Science met at Montreal; the first instance since its organization, fifty-three years ago, that it has ever held a meeting outside of Great Britain. It is a notable association, not only from its present membership and the results of their labors, but also from the fact that it was formed principally through the efforts of such former scientific lights as David Brewster, Humphrey Davy, and John Herschel, whose associates and successors have made it the leading society of the world in all that pertains to science.

Among the distinguished members present from abroad were: Sir William Thomson, Prof. E. B. Tylor; the astronomer, Robt. S. Ball, of Dublin, Prof. Roscoe, Prof. Dewar, Captain Pitt, Sir Lyon Playfair, Prof. E. H. Schafer, Prof. William A. Tilden, Boyd Dawkins and others of note; while of the eminent scientists on this side of the water were: Principal J. W. Dawson, and Prof. T. Sterry Hunt, of Montreal, Professors Geo. F. Barker, Mendenhall, Rowland, Asa Gray, Putnam, Newbury, Youmans, Scudder, Minot, etc.

We are indebted to Professor J. D. Parker, U. S. A., for copies of news-

papers containing reports of the proceedings and for the use of his letters to the Kansas City *Journal* which we use freely for the benefit of our readers:

"This is really the British congress of science, and is a large and powerful body of men. Montreal is full of English professors, with a multitude from all portions of the continent. Members of the American Association for the Advancement of Science have been made corresponding members, and we have delegations of professors from all parts of the United States. The meeting has also brought together many notables in the political and business world.

"Professor Cayley, LL.D., F. R. S., the retiring president, is absent, and Sir William Thomson gave the address of the retiring president. Sir William Thomson was a second wrangler at Cambridge, and is one of the leading electricians in the world. He has published a great variety of papers, making important contributions to his department, and on the completion of the Atlantic cable in 1866 was knighted and presented with the freedom of the city of Glasgow. The English Government and institutions of learning have showered down upon him about all the honors and degrees possible, and he seems to be worthy of them.

"The first day was a notable one. During the morning hours the various sections were getting into working order. There are sections in mathematical and physical science, chemical science, geology, biology, geography, economic science and statics, mechanical science and anthropology. The papers read before these sections are from the most distinguished men in their several departments, and contain the most recent developments.

"At 4:30 P. M. there was a civic reception at Queen's Hall, when the mayor of Montreal, who wore his chain of office, gave the members of the Association a hearty welcome. The hall was crowded and the platform was full of distinguished men from England and America. Sir William Thomson acknowledged in cordial terms the hearty welcome extended by the mayor. Sir John A. McDonald, the premier, then came forward and addressed the meeting, making a very pleasant address of welcome in behalf of the dominion.

"In the evening Queen's Hall was filled to overflowing with an audience of gentlemen and ladies such as seldom convene in this country. As we looked upon the sea of upturned faces, a gentleman from this side of the water remarked: 'This is an opportunity of a lifetime.' His excellency the governor-general, Lord Lansdowne, Lady Lansdowne, and suite, were on the platform. Lord Lansdowne gave a most excellent address, which received frequent applause. The lord is a clever speaker in the English sense.

"Lord Rayleigh's address, the president elect, was the event of the evening. Lord Rayleigh is a very eminent man in the higher mathematics and physics. He gave a rapid review of science in his department of physics. He spoke very feelingly of the death of Sir William Siemens, who has occupied a very conspicuous place in the working of the Association and in the development of the dynamo machine. He was also actively engaged in many other inventions which have proved of great use. The address summed up the progress of science

in the departments touched in a comprehensive way. The lecturer spoke of the saturization of iron by magnetism, the resistance offered by the coil to the passage of electricity, the beautiful and mysterious phenomena attending the discharge of electricity in nearly vacuous spaces, the mechanical theory of heat, the dissipation of energy, the mechanics of viscous fluids, the friction of oiled surfaces, the nature of gaseous viscosity, the investigation of the spectrum, the visible and ultra-violet spectrum, the velocity of light, the telephone and phonograph, the scientific work of Maxwell, and the prospects of experimental science. Lord Rayleigh favored the modern tendency to give less Greek and Latin, and more German and French in our college courses. The address was loudly applauded, and I believe there is more applause in the British Association than in the American Association.

"Hon. Dr. Chauneau addressed the meeting in French, and spoke of the work which the Royal Society is doing in Canada. There were several other speakers during the evening.

"I see other visitors here from the West. Among them I notice Marcus Baker, of the United States Coast and Geodetic Survey, in charge of the Magnetic Observatory at Los Angeles, Cal. Prof. W. I. Stringham, Professor of Pure Mathematics in the California University, is also here.

"A general survey of the British Association of Science impresses one with the magnitude of the work which they are accomplishing. Fifty-two years since the society was organized has seen almost an entire revolution of science. Old theories have passed away and old beliefs have vanished. Sir William Thomson referred to the meeting of the Association where a physicist demonstrated that it would be impossible for a steamship to cross the Atlantic. But in spite of this demonstration the Association now finds itself on the other side of the Atlantic. These English savants are thoroughly in earnest in their scientific studies and researches. No expense, and no amount of time and study are spared to attain the results aimed at. The English scientist is a specialist in his chosen branch and knows all about it, although he may be a child in other things. One of the scientists asked another about the location of a certain room in the steamer, when the other scientist pulled out an elaborate plan of the ship, and pointed out the room to him.

"The work in the various sections is first-class. It is refreshing to hear papers read by the masters in science, whose books one has studied from his youth. Prof. Asa Gray is here, and is honored by the English scientists as the leading botanist, perhaps, in the world. They say there are a great many clever gentlemen in America, and seem to take pleasure in mentioning such names as Gray, Dana, Newcomb, Newberry, Bell and others. The old prejudice against American institutions has almost disappeared, and I believe this meeting of the leading scientists of Europe, in Canada, will result in much good to both countries.

"I have just returned from an excursion to Queb
the Association enjoyed the hospitalities of the city

trip was delightful. We were first entertained by the citizens, and then driven out to Spencer Wood, where the lieutenant-governor gave us a magnificent reception. In the evening Lord Lansdowne gave us the crowning reception, in the citadel on the heights overlooking the city. The English and Canadian scientists do not seem to have heard of prohibition. My cab party of English professors took so much wine that they became quite mellow. On our return down the heights the road was very steep and slippery from a recent rain, and we were obliged to get out and walk. It is amusing to see an English professor with a full line of titles trying to navigate down a steep road in a dark night, when his head is all in a whirl. There is a chance for prohibition work even in the English universities.

"My berth was also occupied by an Oxford professor. He came in after midnight in bad humor. First, some one had taken his umbrella, and then at Lord Lansdowne's party he had lost his McIntosh. It was amusing to hear him give the Canadians and Americans a blessing. He said there were a few 'clever' Americans, but it was a 'beastly' country. There was more real comfort in London than in all the world besides. One of the distinguished English scientists said their ship, in coming over, struck a whale and cut him clear in two! A lady at the table said that was a fish story.

"On Sunday our party was on the river, and we extemporized a devotional meeting on the steamer. About a hundred gathered around the piano, where we sang all the hymns we could remember. Several clergymen were present and addressed the meeting. The English sing some sweet hymns not common to this country. The company represented every phase of belief, but there was a religious fervor truly refreshing. As the old songs welled up and floated across the water reminding many of distant homes and loved ones, I could see the tears starting from many eyes. There is something in any common manhood that overshadows creeds and sects. Religion, pure, undefiled, touches the universal heart, and men from all lands melt together and find that they are common brothers.

"On the steamer I met a Japanese professor from Tokio University. He was sent by the Japanese Government, and graduated at Cambridge, England. He is a follower of Confucius, but said he loved the New Testament in English very much, but the Testament had been translated into such wretched Japanese that he could not understand it. It would be well for the foreign board to look after their Japanese translations. He has charge of the mathematics in the Tokio University, which the government supports at an expense of nearly $400,000 a year.

"The Association will adjourn next Wednesday, and there are many excursions made to places of interest in Canada and the United States. Several hundred of the members will take a free excursion to the Rocky Mountains.

"Some of the speakers in their addresses, referred to their seasickness in the ocean voyage. The mayor of Quebec said probably science would soon overcome this difficulty. Sir William Thomson said probably some way would

be discovered so members could be put to sleep and packed up for the ocean voyage, to awake at a certain day and hour in their various sections.

"Monday was a hurrying day in the British Association. Many important papers had been laid over for want of time, and other papers of equal interest were pressed upon the committees to be read and discussed. The closing days of the Association are always filled to overflowing, and this is especially true at this meeting. Eight sections and subsections are in full blast, and all the rooms are crowded.

"In the section of physical science, Prof. Schuster read a paper on the connection of sun-spots with terrestrial phenomena. He said that this connection was not established beyond a doubt. Observations have been made on this subject for fifty years. On the Rhine the good wine years are coincident with the least number of sun-spots. The greatest number of cyclones occur coincidently with maximum sun-spots. Small comets are more numerous also at the same time. Prof. Rowland showed that the variations in the sun's heat is due more to errors in observations than true change. Mr. W. Lant Carpenter said that the coincidence of maxima and minima of magnetic disturbances, auroral displays, average rainfall, etc., with sun-spots, in a period of eleven and one-tenth years, had long been observed.

"Professor Darwin, son of Charles Darwin, read a report on the harmonic analysis of tidal observations. He regretted that the admiralty is satisfied with the old methods of tidal reduction and has no intention of making any contribution to our tidal knowledge of instituting harmonic analysis of tidal records. The tides of the North German Ocean are now being reduced according to the harmonic methods by the imperial admiralty. Mr. Breson, in charge of the Natal Observatory, and Mr. Gill, Astronomer Royal at the Cape of Good Hope, are reducing the tides according to harmonic methods. Similar work is being carried on at several points, and the result will be of much interest for the purpose of valuing the degree of elastic yield of the earth's figure. Prof. Lawrence said that a large number of wrecks in past years was due to our want of knowledge of tides and tidal currents in the Gulf of St. Lawrence.

"Professor Schuster read a report of a committee appointed for the purpose of considering the best methods of recording the direct intensity of solar radiation.

"Professor Douglas Archibald spoke of the sun-glows and halo in connection with the eruption of Krakatoa. He believed these sun-glows were due to the widely diffused dust from the eruption of Krakatoa. He also spoke of the remarkable halo to be seen near the Sun. On looking up into the sky and shading the eyes, a cloud would be seen before the Sun, edged with a halo of a pink or salmon color. This halo does not seem to be reduced in the slightest degree and evidently has no connection with the vivid sunsets. The dates of the commencements of the sunsets form a ring of dates, beginning at the Isle of Java, and the further the distance from Java the later the dates of rings.

"Mr. Henshaw read a paper on frasil ice, or anchor ice. The paper traveled over the common theories without adding much to our knowledge. Probably

the ice forms at the surface, and is carried down where re-gelation takes place. Prof. Claypole said frasil ice was found even in the head-waters of the Thames. The stones in the bottom of streams seem to radiate their heat in clear water so rapidly that anchor ice was formed.

"The Earl of Ross read papers on 'An Electrical Control for Equatorial Driving Blocks,' and on 'Polishing the Secula.' This is a son of Sir John Ross who constructed the forty-foot reflecting telescope.

"Professor Douglas Archibald read a paper on 'Some Preliminary Experiments with Anemometers attached to Kite-wires.' He wanted to send up his anemometer on a kite, but could not make his kite stand still in the air so as to get a correct measurement of the wind, until he devised some inverted funnels attached to the kite's tail which the wind caught, and so pulled the kite both ways at once. In this way he could send up his anemometer to almost any height, and make his kite stand perfectly still for hours. These English savants are very ingenious to devise methods to carry on their investigations.

"In the section of chemistry Sir Henry Roscoe read an interesting paper on the diamond deposits of South Africa and the ash of the diamond. Mr. Harold B. Dixon read a report on chemical nomenclature, advocating the adoption of a nomenclature which should become universal and permanent. Many other valuable papers were also read in this section.

"In the geological section President W. T. Blanford, F. R. S., occupied the chair and Prof. T. G. Bonney, F. R. S., read a paper 'On the Archæan Rocks of Great Britain.' The paper indicated a general correspondence between these rocks and the Archæan rocks of Canada.

"Dr. T. Sterry Hunt followed with a paper on 'The Eozoic Rocks of North America.' He found among the pre-Cambrian strata of North America an invariable succession of crystalline stratified rocks, which have been by him divided into several groups, the constituents of which become progressively less massive and less crystalline, until we reach the sediments of palæozoic time, of which the Cambrian rocks, with the exception, perhaps, of the lowest or fundamental gneiss, present evidences, direct or indirect, of the existence of organic life at the time of their deposition. He included these rocks under the general title of Eozoic, a term first proposed by Sir William Dawson. This paper was discussed by Major Powell, James Hall, Sir William Dawson and others.

"Professor James D. Dana contributed a paper, 'On the Southward Ending of the Great Synclinal in the Taconic Range.'

"Mr. V. Ball, F. R. S., read a paper, 'On the Mode of Occurrence of Precious Stones and Metals in India.' The paper treated of the diamond, ruby, sapphire, spirel, beryl, emerald, lapis lazuli, gold and silver, and gave information not contained in the books.

"The section of biology has attracted much attention, and valuable papers were read by Mosely, Struthers, Dobson, Marshall, Saunders, Hughes and others.

When Lieutenant Greely and wife arrived, they were met at the station by

Capt. Pim, who accorded them a hearty welcome. They drove to a hotel, and shortly afterwards were waited upon by a deputation from the British Association, and conducted to McGill University. Lieut. Greely seemed suffering greatly from the fatigue of the journey to this city.

When Greely entered the hall he was immediately surrounded and welcomed in an impressive manner by Sir Henry Lefroy. Sir Henry said he as well as all geographers and scientific men of Great Britain and the whole of Europe had followed with great interest the efforts made to relieve his party, and hailed with the keenest delight their rescue. Lieutenant Greely, in reply, remarked that he was delighted at being invited by the British Association and at attending, and only wished he could do more than he would be able to do. He would, of course, connect himself with the geograpical section principally, and would contribute some of the results of the expedition. In reply to Sir Henry's inquiries, Lieutenant Greely stated that the meteorological observations had not been reduced. In an animated manner he proceeded to speak of some of the work done by the expedition. One of the most interesting results will be a comparison of the swinging of the pendulum, at the furthest point north reached, with that at Washington. He explained that although most of their instruments had to be abandoned, the pendulum apparatus, which weighed ninety pounds, was brought back and has been sent to Washington. He remarked with evident pride that he had told his party that the pendulum was a very important instrument, but that if one man of the twenty-five complained he would abandon it. None would hear to this, and a very important comparison is thus made possible. Speaking of observations of temperature, he stated that the lowest temperature ever recorded was that experienced in February last, when the mean temperature was 50° below zero.

"On Friday Lieut. Greely read a paper on Arctic exploration in the section of Geography. His presence attracted a vast throng. Lieut. Ray was present and partook in the discussion. Lieut. Greely said the tides from the North Pole were warmer than those from the South, and he favored the existence of a north polar sea.

"In the section of Anthropology, Mr. F. H. Cushing read a paper on the development of industrial art among the Zunis of New Mexico. Mr. Cushing joined the tribe of the Zunis in order to find out their secrets.

"He was keenly observant, and he shows a series of remarkable diagrams, explaining the result of these observations. The Zunis live chiefly in the desert, and anything they grow they produce by irrigation. Their pueblos or towns are built of mud and fragments of stone. Mr. Cushing has prepared a great number of elaborate pictures, showing their works of pottery, which includes a great number of curious designs. All their present examples had their origin in the rude necessities of a rude life. Gradually, as though by process of evolution, they assumed conventional shapes, and, in the course of time, conventional decoration was added. The rude vessels, at one time subservient only to daily wants, had a symbolic character given to them, and many of them now served

the sacred purposes of religion. Mr. Cushing believes that the study of archæology should be backwards and not forwards. By seeing these people in a savage state, becoming acquainted with their primitive modes of life, their rude arts, their struggles to survive and to equip themselves with what implements and devices their limited ingenuity could plan, accurate analogies might be made of the primitive condition of other races. For example, in South America where large animals abounded, the savage tribes used their paunches, after they had killed them, as their first holding vessel. After the lapse of time, when their powers of ingenuity had expanded, and they were able to make a vessel of clay, it took the shape of the animal's paunch. And, to complete the resemblance, it had colored streaks up the sides to resemble veins. So with the Zunis. They first made a rude basket out of grasses and strips of bark. Then they put moist clay upon the interstices to stop the leakage and used it for cooking purposes. The discovery that clay was fire-proof was speedily taken advantage of in the structure and baking of a number of vessels, whose shape was determined by some local circumstance or necessity. These vessels, then, gradually assumed symbolic shapes, as we have mentioned. To understand their significance it was necessary that he should first master the Zuni language, and this Mr. Cushing has done so well that he speaks it like a native. Each vessel had its own peculiar name, and once he got the etymology of it, the ritualistic significance of the vessel was soon apparent. There was a peculiar bowl which was of the highest religious value. It had a representation of the clouds where the gods were supposed to dwell; of the sea, as representing the water which the gods, when in propitious mood, sent down to them in the form of rain, and for which they were very grateful, as the climate was hot and dry; of water beetles, which were types of spring, as they were found in the water only in this season, and of certain forms of flies as types of summer. Winter was omitted. They held that winter was sent by the gods as a punishment, and they did not consider it as one of the regular seasons. Mr. Cushing has reproduced every form of vessel and every instance of architecture from the earliest history of this interesting period, and his descriptions and expositions are fraught with the deepest interest.

"Last evening Dr. Dallinger gave the most brilliant lecture of the meeting on 'Researches of the Modern Microscope.' Queen's Hall was filled with an audience made up of the most distinguished men of two continents. The lecture was illustrated with the calcium light, and it has never been my good fortune to have seen anything to compare with it. Lord Rayleigh declared, at the close of the lecture, that he had never seen it surpassed. The lecture embraced the results of over ten years of observation, of two observers. The observations were made continuous, one observer working while the other slept, so the whole history of the bacteria was gathered up. One can judge of the minuteness of these animals when we consider that 50,000,000 of them will occupy one-hundredth part of a cubic inch. At some points of his investigations, Dr. Dallinger was compelled to wait until more powerful lenses than had been known to the world could be constructed. Perfect images of these infinitesimal animals were thrown

upon a white screen fifteen feet square, and the beauty of these monads, which sometimes resembled the most exquisite plants, cannot be described. Prof. Dallinger said they were evidently created to work over dead matter, and prepare it for use by living organisms. Sometimes one of these strange forms would begin to constrict around the center, while both ends would become an animal, and then each would begin to pull in opposite directions, and 'with a long pull and a strong pull and a pull all together' they would break the ligament binding them together, and both spin off in their new orbits. Dr. Dallinger's investigations have utterly disproved spontaneous generation.

After a most busy week, in which results were put on record of the recent work of a great number of savants in numerous departments of investigation, the Association closed up the business of its first meeting in America, at Montreal, September 3. The number of papers read and the discussions were always interesting, but there have been no such wonderful discoveries announced or original theories advanced as stand out so prominently in the *Transactions* of the British Association of many former years. It would not be just, however, to assume that on this account the work done indicates any less keenness in scientific research.

Among the papers read in the mathematical and physical science section that excited considerable attention, was one by Prof. O. J. Lodge, as to the seat of electromotive force in the voltaic cell. Sir William Thomson said he regarded the paper as a landmark on the subject. Then Sir William threw some light on the matter from his own observation and experience, and he was followed by Profs. Fitzgerald, Silvanus Thompson, Dr. Fleming, Prof. Gibbs, and Drs. Schuster and Macallister.

In the chemical section, Prof. Frankland, the well known author, took up the subject of the batteries for the storage of electrical energy. While admitting the great loss of power in these batteries when not in use, he was disposed to think from his experiments that they have a brighter future than many electricians are willing to admit. After him came Prof. George F. Barker, who called attention to the shortcomings of the batteries, which, according to his calculation, do not return over 6 per cent of the energy put into them.

A paper before the geological section, by W. F. Stanley, F. G. S., had the following points: "The theory of Dr. Croll, accepted by many geologists, is that the former glacial periods in the northern hemisphere were due to greater eccentricity of the earth's orbit and to this hemisphere being at the time of glaciation in winter perihelion. This theory is supported upon conditions that are stated to rule approximatively at the present time in the southern hemisphere, which is assumed to be the colder. Recent researches by Ferrel and Dr. Han, with the aid of temperature observations, taken by the recent Transit-of-Venus expeditions, have shown that the mean temperature of the southern hemisphere is equal to, if not higher, than the northern, the proportions being 15.4 southern, 15.3 northern. The conditions that rule in the south at the present time are a limited frozen area about the south pole not exceeding the sixtieth parallel of latitude,

whereas in the north frozen ground in certain districts, as in Siberia and North-western Canada, extends beyond the fiftieth parallel: therefore by comparison the north, as regards the latitude in which Great Britain is situated, is at presen the most glacial hemisphere. As it is very difficult to conceive that the earth had at any former period a lower initial temperature, or that the sun possessed less heating power, glaciation in the north could never have depended upon the conditions argued in Dr. Croll's theory. The author suggested that glaciation within latitudes 40° and 60° was probably at all periods a local phenomenon, depending upon the direction taken by ærial and oceanic currents, as, for instance, Greenland is at present being glaciated. Norway has a mild climate in the same latitude, the one being situated in the predominating Northern Atlantic currents, the other in the southern. Certain physical changes suggested in the distribution of land would reverse these conditions and render Greenland the warmer climate, Norway the colder."

In regard to sunspots and terrestrial disturbances, Prof. Arthur Schuster, of Owens College, Manchester, said their periodicity was not regular. Sometimes they appear every eight years, and sometimes not for sixteen years. The period is about every eleven years. There is ground for believing that there are two periods of ten and a half and twelve years superposed on one another. Magnetic variations, that is, variations of the magnetic needle, occur at such times, which are quite marked. The magnetic needle points to the north and the south. It does this, however, approximately, and follows the course of the sun somewhat. In the morning it begins traveling westward, and in the afternoon it starts on its run to where it began. This daily excursion of the needle is much greater when there are many spots on the sun. The proportion in England is as three to two, and in Germany as seven to four. At times, too, the needle travels irregularly to and fro. These needle vibrations are magnetic storms. The speaker referred to the noted storms of 1859 and 1872, at the time of great outbursts on the sun, and said that if the sun were of solid steel, magnetized to the highest extent of which it is capable, it would not affect terrestrial phenomena to such an extent, It was rash to say that the space between the earth and the sun did not contain sufficient matter to conduct electricity from one to the other, but leaving electric influence out of the matter, because we know nothing of the subject, we come to the question, "Does the sun radiate more or less at the time of the prevalence of sun spots?" This was not definitely ascertained. The trouble has been in trying to ascertain the sun's radiant heat, and we have not been able to get rid of disturbing factors, one of which is the variance in the absorption, reflection, etc., in the atmosphere at different times of the day. Prof. Schuster suggested the establishment of an observatory station on Himalaya Mountains, about 20,000 feet above the level of the sea. He then pointed out the difficulties in the way of determining the solar heat, and called attention to the thermic curves. During the period between 1810 and 1860 there was a remarkable correspondence between the mean temperature curves and the prevalence of sun spots in unusual numbers. The good wine years on the Rhine correspond with the years of mini-

mum sun spots. Hot summers follow after a period of maximum sun spots. Destructive cyclones on the Indian Ocean and around the West Indies, it has been observed, are greater in the years of maximum sun spots. At the time of many sun spots there was seen a comparatively large number of comets around the sun. The speaker thought it not improbable that the periodicity of sun spots was produced in some way by meteoric streams whose orbits approached the sun at the times of the frequent sun spots. The address was discussed learnedly, and further light was thrown on the subject by Profs. Balfour Stewart and W. Lant Carpenter, who took up the matter of short periods common to solar and terrestrial phenomena, and a report was submitted on meteoric dust. Other matters discussed were the measurement of solar radiation and recent progress in photographing the solar spectrum. The Earl of Rosse epxlained an electrical control for equatorial driving clocks.

An interesting address before the chemical section was by D. W. H. Perkin, Ph. D., F. R. S., of Sudbury. He turned the room into a laboratory, and gave a most exhaustive address on coal tar coloring matters, which was illustrated by numerous experiments. The beautiful colors obtained from the various products of coal tar distillation were exhibited, the methods of manufacture and application explained, and reference was made to the discoveries of new ways of producing cheaply and abundantly the substances used in making the most brilliant dyes. The speaker colored strips of yarn, washed them, fixed the colors, and then exhibited them all in full view of the audience.

"There is a hurrying to and fro, and the great scientists are getting ready to depart in various directions. One might as well try to eat a buffalo for breakfast, or drink the water that tumbles down Montmorency Falls, as to report the British Association of Science. I have only tried to give a few glimpses of the workings of this vast organization which formulates the best scientific thought of the British Empire."

ASTRONOMY.

SUN AND PLANETS FOR OCTOBER, 1884.

W. DAWSON, SPICELAND, IND.

The earth in its revolution round the Sun moves nearly one degree a day, [and] this gives the Sun an apparent motion eastward to the same extent, equal to [abo]ut four minutes of time. So the Sun's R. A. (distance east of Vernal Equi[nox] on celestial equator) increases nearly four minutes every day, and about two [hou]rs a month. On the 1st of October it is 12h. 33m., and on the 31st 14h.

25m. This eastward motion of the Sun makes the stars appear to go as far westward and set four minutes earlier every day.

The Earth's orbit being inclined to the celestial equator, and now moving in its northern half, gives the Sun a southern declination; which, October 1st, is 3° 32′, increasing to 14° 25′ on the 31st. This increasing southern declination of the Sun causes a shortening of our days from 11h. 40m. to 10h. 20m. Spots on the Sun are still numerous, though quite variable in number and size. Only fifteen were visible September 2d, but ninety were counted on the 11th; one large group near the center of the Sun having seventy-seven spots.

Full Moon occurs on the 4th of October, when there will be a lunar eclipse —total in Europe and Africa; but the Moon don't rise here until the total phase is passed; so there will only be a partial eclipse in Eastern America—but *it* will hardly extend as far west as Kansas City—being over before the Moon rises there. On the 18th new Moon occurs, when there will be a partial eclipse of the Sun, visible to northwest America, north Pacific Ocean, and Eastern Siberia. It will extend over California, Oregon, and Washington Territory, just before the Sun sets there.

The morning skies in October this year will display a diamond brightness. Some of the most brilliant stars are now at their heights in early dawn—notably Sirius, Aldebaran, and Cappella, the grand constellation of Orion, and the beautiful Pleiades. All the bright planets, except one, are also morning stars. On the 1st Mercury rises at 4:30 A. M., just a little north of due east. Thus it may be easily seen for a few mornings in the fore part of October. Venus rises soon after 2 A. M. and is much the brightest star now visible. Through September it could easily be seen with the naked eye at 9 A. M. when near the meridan. It will not be quite so bright in October. It still crosses the meridan about 9 in the morning, at an elevation of 62° in the fore part of the month and 52° on the 31st. Venus will be near Jupiter in the morning of the 6th. It also passes near Regulus, a star of first magnitude, in the evening of the 7th, and will be near enough to be worth looking at in the mornings of the 7th and 8th.

Mars is now a day object—rising about 9 A. M. in the southeast and setting near 7 P. M. in the southwest. Hence of little or no interest. Jupiter is just north of Venus in the morning of the 6th. They are both fine objects for observation with a telescope. But Saturn is still prettier, and four hours west—near the boundary between Taurus and Gemini; on the meridian a little before 5 A. M. October 1st, and two hours earlier on the 31st. The ring is near its widest, and is a lovely object for observation. In the latter part of October Saturn will rise about 8 P. M. Uranus is near the Autumnal Equinox, in 12 hours of R. A. Neptune is in Taurus, about 7° southwest of Pleiades.

SOLAR DYNAMICS—SOME NEW ASTRONOMY.

REV. JAMES W. HANNA.

We hear of the "new astronomy" on every breeze. Can we have a finger in the matter? The advice of Mrs. Jack Means is, "While you're gitten, git a plenty." The builders of the new had better gather it all in. So here is our offering.

In an article on the forces of inorganic nature, published in the September number of this REVIEW, speaking of repulsion as a force co-ordinate with attraction, I said, "This drives volatile matter from the comets, thus making their tails. This causes the diurnal revolution of the planets. This gives to the several planets their distances from the Sun." To some this may have appeared a reckless assertion. It was made, however, in the light of convincing proof. That proof could not be presented then. It, and much else, had to be reserved for another time. Having accepted the doctrines advanced in my former article; regarding all the physical attractions in the realm of inorganic nature as of one origin, and all the repulsions as of one origin, believing heat to be something else than motion, that repulsion is from its self-repellence, and attraction from its affinity for matter, and that heat is a factor in gravitation; with these principles, wanting further confirmation, I went into the realm of astronomy to see what answer we might get from this quarter touching these matters. Here I got more than was expected; much that was not expected. Some clearing of the decks was indulged in. Original impulse as effecting any sort of planetary motion was discarded. Because there is no perfect vacuum, and, therefore, always some resistance, and because of counter attracting forces that would in time bring to an end the momentum caused by an original impulse, we conceded that all planetary motion results from forces in constant operation. The question then was how account for what is called the centrifugal force? Next, what causes axial revolutions?

On my theory of attraction and repulsion, there may be from the same attracting source little attraction, more attraction and most attraction, owing to the nature of the body affected. And so there may be from the same repelling source, little repulsion, more repulsion, and most repulsion, owing to the nature of the body repelled. By this theory, in the solar system, those planets in whose composition is the greatest proportion of heat will be farthest from the Sun; and those planets in whose composition is the least proportion of heat will be nearest the Sun. So we have it. The hotter planets are more remote; those relatively more material are nearer. To this Venus is no exception, though its case is peculiar. Then, however it may be accounted for, we find the distances of the planets determined as by a law growing out of these principles, and as though one law reigned throughout the realm of nature.

As to axial revolutions, if these result from forces in constant operation, but

two processes are conceivable. One by two pulls from different directions, having different centers of force, on different sides of the center of the revolving orb. The other by a pull and a push from the same direction, having such different centers of force. For a while I favored the first of these. Now it is rejected, for two reasons. First, it seems manifest that all attracting forces affecting an orb would have a common center. Second, as the satellites are subject to these pulls from different directions, they too should revolve if this caused axial revolutions. On the other hand if axial revolutions are caused by repulsion, first, only hot bodies will cause these revolutions. So we have it. The planets under the rule of the sun all revolve; the satellites under the rule of the cool planets do not, but, held as by a strong grip, they move around, as that grip causes them to move. Second, if the axial revolutions are caused by repulsion, the rapidity of the revolution will be affected, first by the force of the repulsion, and second, by the length of the diameter of the revolving orb; as this will afford more leverage to the diverse forces. The student of astronomy will see that the axial revolutions seem to harmonize with a law growing out of these principles. It may be asked why grant that attraction and repulsion, the pull and the push, have different centers of force in the revolving planet? If where there is most heat there is most repulsion, and where least heat most attraction, the repulsion will always be strongest on the afternoon side of the planet. With more push on the one side what can we have but axial revolution. And the rapidity of the revolution must be determined in great measure by the factors above named.

While studying the movement of the planets diagrams were freely used, diagrams of movement at various rates and in many different directions. And here much may be learned. You may conceive of the Sun as moving on any line passing through its own center; assume that it is moving at a certain rate, and you may diagram the movement then required of the solar system. The movement on any line requires a diagram of its own different from any other. For example, if the earth moves in the plane of the ecliptic, there is but one line on which the Sun can be moving, viz: that of the intersection of the ecliptic with the plane of the solstitial colure. Again, if the ecliptic is made up of a succession of parallel planes, there is but one line on which the Sun can be moving, viz: the line on the solstitial colure perpendicular to the plane of the ecliptic. So also any given velocity requires a diagram of its own. Any change of direction, or any change of velocity requires a change of the diagram representing the movement of the system. The diagrams here given on Plate I represent the movement of the earth if the Sun moves in the plane of the celestial equator on the line of its intersection with the solstitial colure, an[illegible] at a velocity of twenty-seven miles per second. Fig. 1 is a hor[illegible] view [illegible] from the [illegible] Fig. 2 is a perpendicular view as seen [illegible] In F[illegible] [illegible]erihelion the earth is north, [illegible] [illegible]een [illegible] In Fig. 2, at the vernal [illegible] [illegible]at th[illegible] equinox below it, as see[illegible] [illegible]lud[illegible] [illegible]s movement, and gi[illegible] [illegible] of [illegible] [illegible]ce[illegible] [illegible]ns.

PLATE I.

Fig. 1

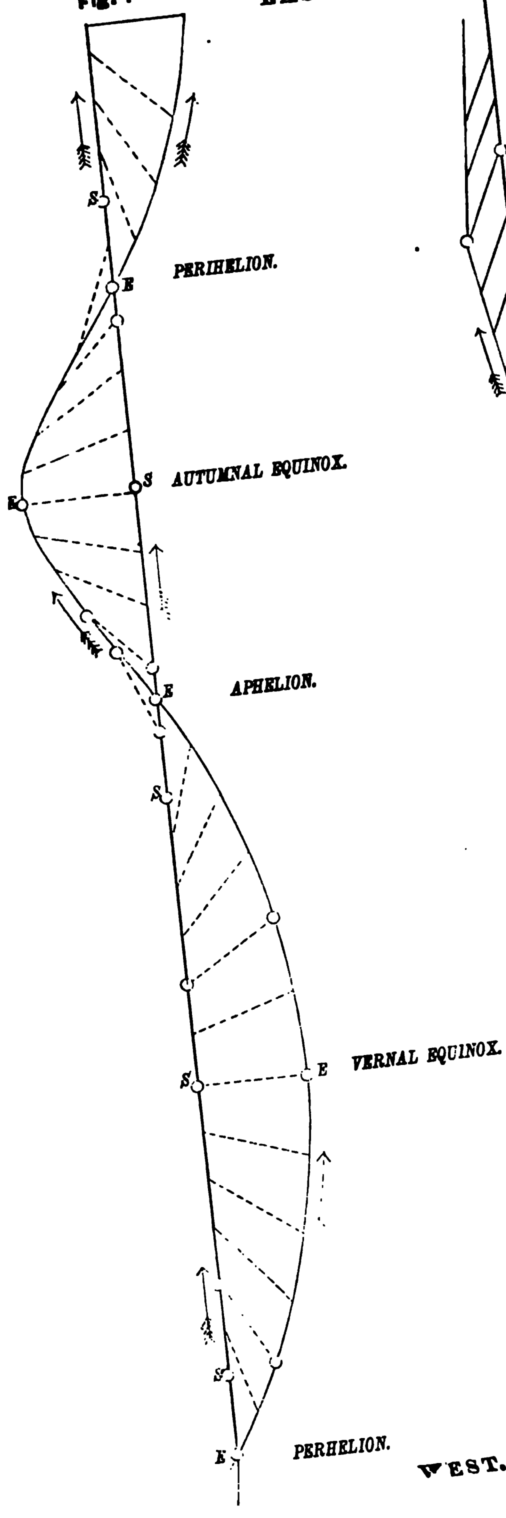


Fig. 2

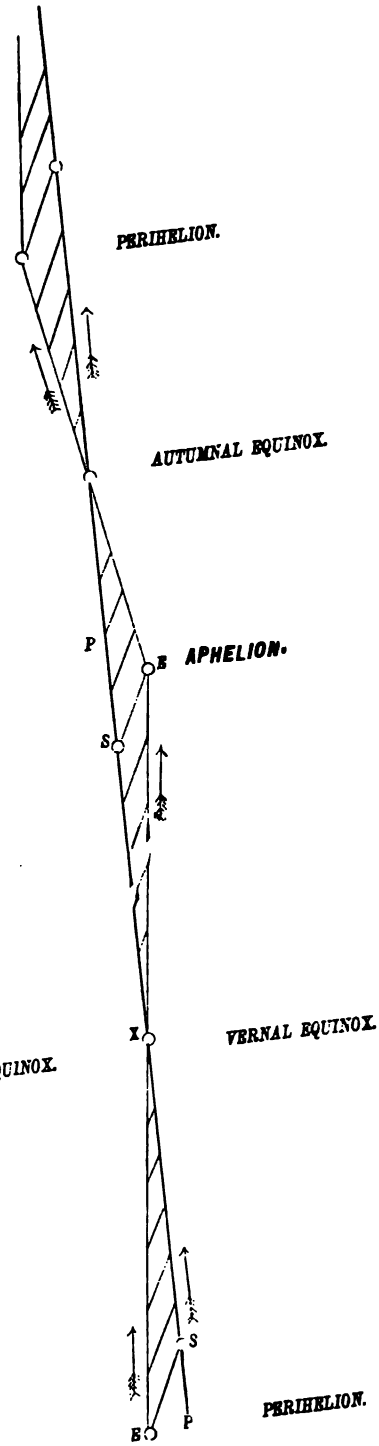
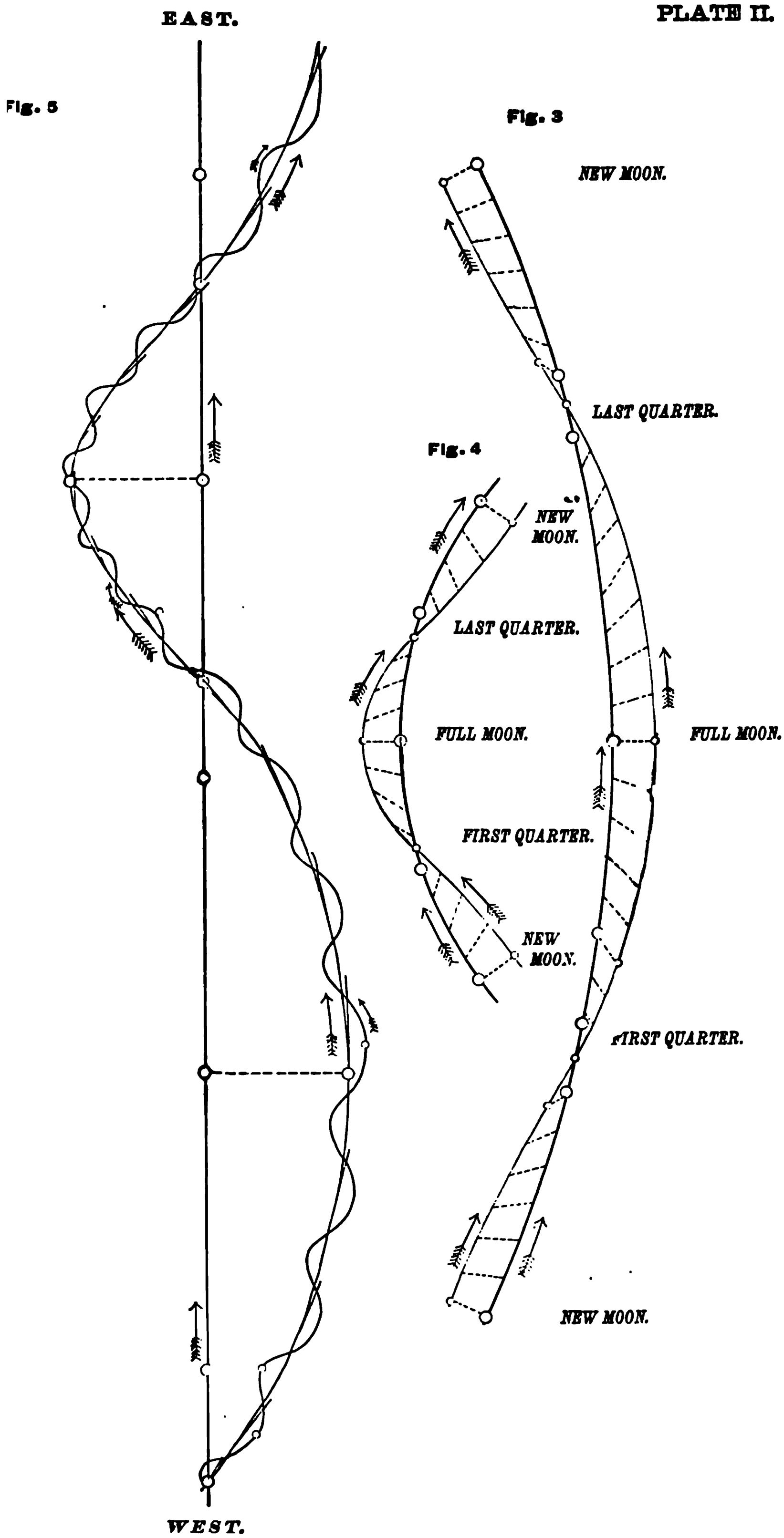


PLATE II.



EAST.
Fig. 5
Fig. 3
NEW MOON.
LAST QUARTER.
Fig. 4
NEW MOON.
LAST QUARTER.
FULL MOON.
FULL MOON.
FIRST QUARTER.
NEW MOON.
FIRST QUARTER.
NEW MOON.
WEST.

And now let us consider some things preparatory to making diagrams. We have the celestial heavens, with the North and South Poles, the celestial equator, and the ecliptic. These give us our points of the compass, and enable us to locate planes. In the diagrams the following things are to be observed:

1. Parallelism of axis. The planets must keep their equatorial planes in position.

2. A direct line from the Sun to the center of the earth must never strike the earth more than 23½° north or south of the Equator, but must reach that latitude, once north, and once south, during each revolution.

3. In each case we have a hypothesis as to the rate of the Sun's motion; hence we know how far it would move during the revolution of each planet. This distance, and the distance of each planet are to be carefully observed in the scale adopted in the diagram.

4. During the revolution of each planet, the Sun must pass over nearly equal distances in equal times.

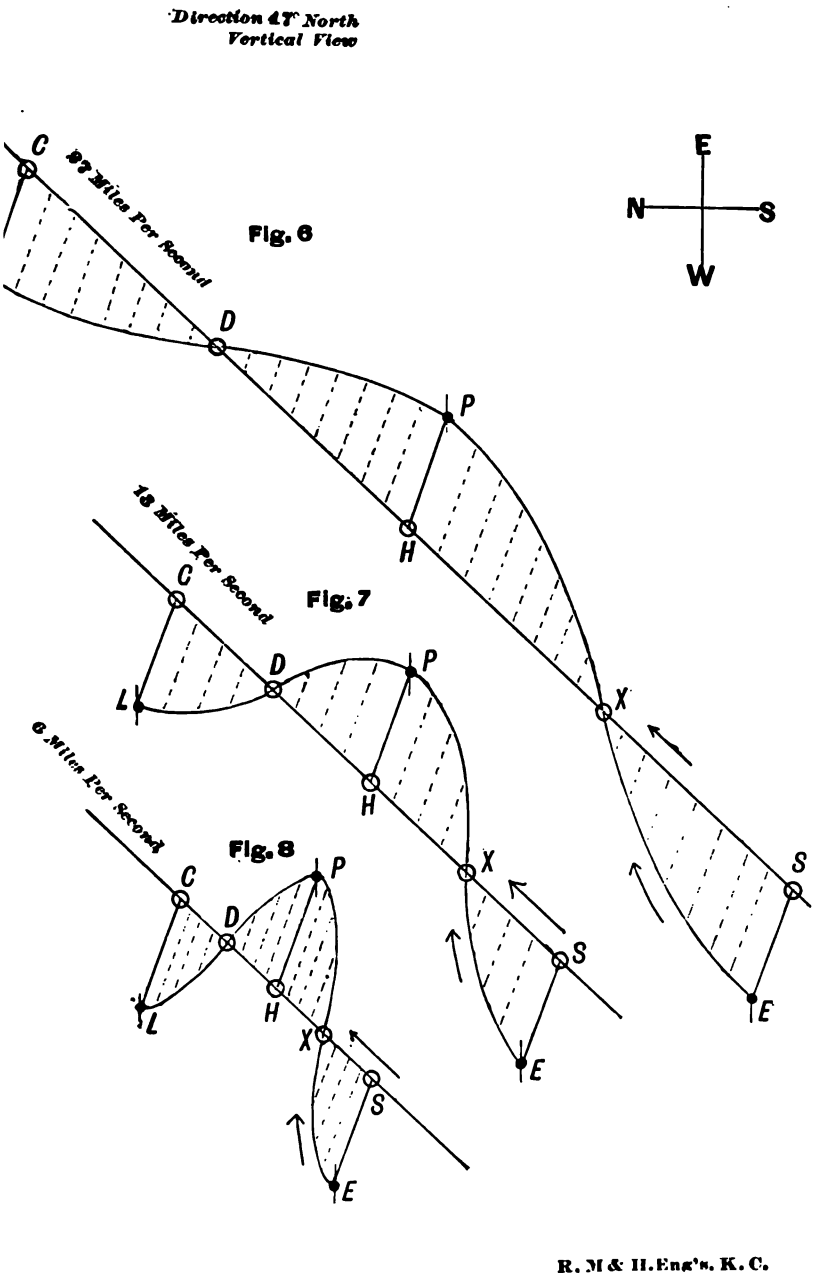
5. The relative position of each planet and the Sun during a revolution must be such as to form an ellipse.

Observing the above conditions we present a few diagrams. Each shows what the path of the earth would be, did the Sun move in a given direction and at a given rate. These diagrams have reference not only to a particular latitude, but to a particular point in the heavens: for not only the latitude, but the longitude of the movement, affects the diagrams. These few diagrams, among the many that might be given, serve to illustrate general principles.

In the expanse of the universe, you may, if you please, regard the solar system as small as a train of cars. If it were as small as a compass, or as the instruments which the astronomer uses, its pointings would still be exact. We want to use the system itself, as though it were an instrument, for certain mathematical demonstrations. Our figures are made on a plane either of longitude, or of latitude, in which the Sun is assumed to be moving.

Plates III, IV, and V are on the plane of the solstitial colure. In the diagrams on Plate III the movement is toward 47° north declination. In Fig. 6, the rate of the Sun's motion is twenty-seven miles per second. At this rate, the Sun moves in one year nine times the distance from the Earth to the Sun. We draw our lines accordingly. The line S C represents the Sun's line of passage in one year. And S E represents the earth's distance from the Sun, which, during the year, is to vary so as to form an ellipse. Next we divide S C into four equal parts. The Sun passes over one of these during a quarter of a revolution. We propose to start at the winter solstice. And we know just where to locate the Earth. There is but one place possible. At the winter solstice the earth is in this plane, the plane of the solstitial colure. And then, a direct line from the Sun to the earth's center makes an angle of 23½° to the plane of the earth's equator. Then the earth can only be at E. In six months the Sun will be at H. And the Earth is again in this plane, the plane of the solstitial colure. And now

ATE III.



R. M & H. Eng'rs. K. C.

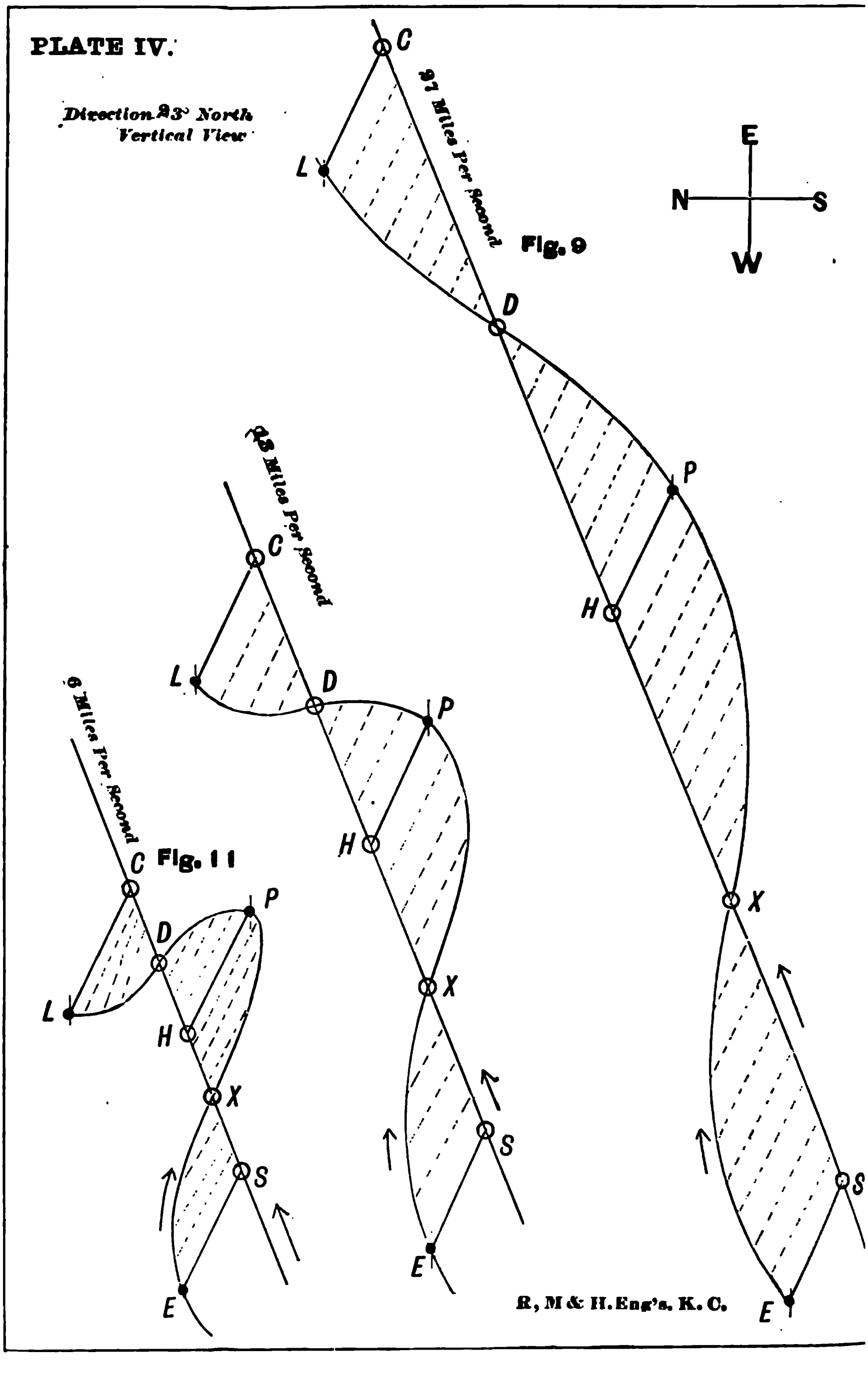
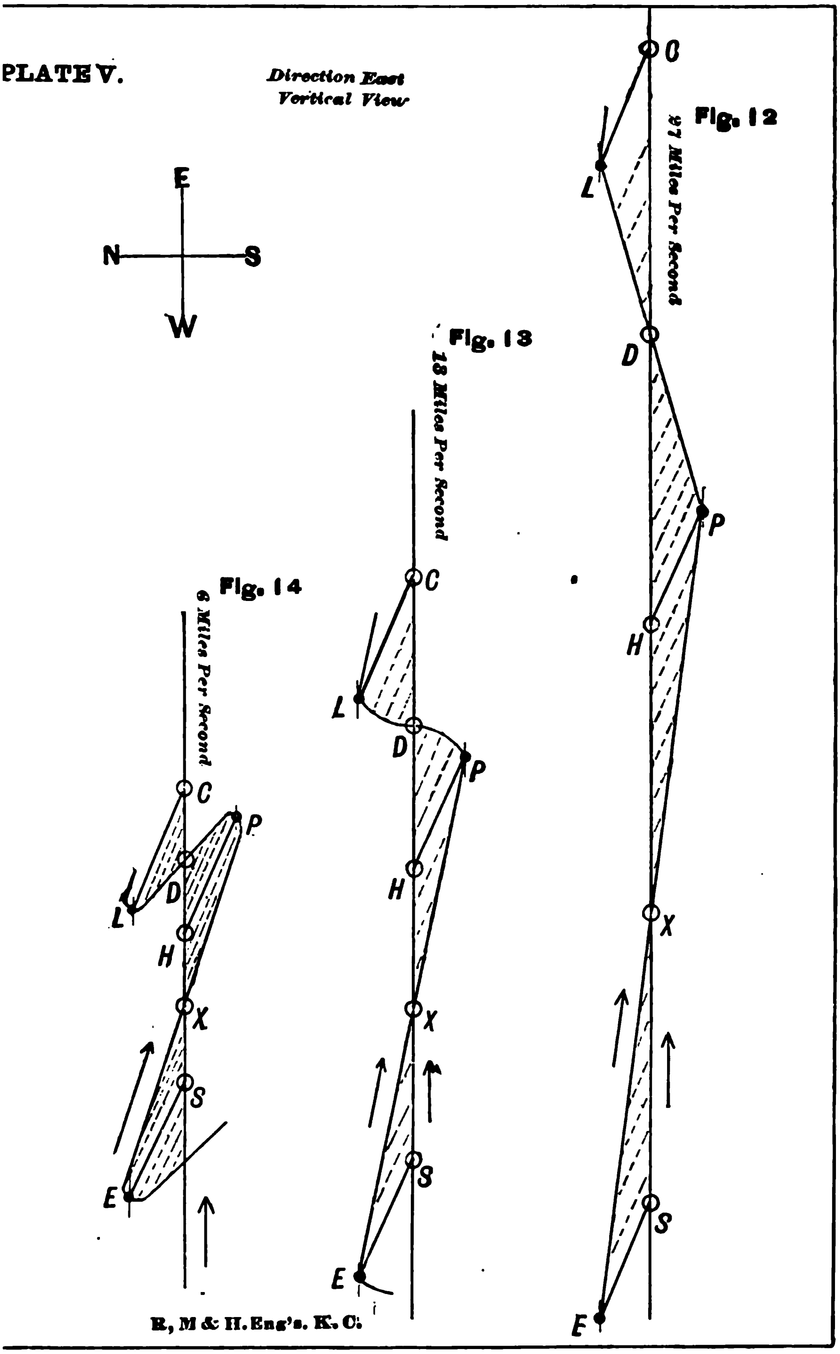


PLATE IV.
Direction 23° North
Vertical View
E
N
S
W
97 Miles Per Second
Fig. 9
C
L
D
P
H
X
S
E
48 Miles Per Second
C
L
D
P
H
X
S
E
6 Miles Per Second
Fig. 11
C
D
P
L
H
X
S
E
R, M & H. Eng's. K. C.

PLATE V.


Direction East
Vertical View
E
N
S
W
Fig. 12
97 Miles Per Second
C
L
D
P
H
X
S
E
Fig. 13
18 Miles Per Second
C
L
D
P
H
X
S
E
Fig. 14
6 Miles Per Second
C
P
D
L
H
X
S
E
E, M & H. Eng's. K. C.

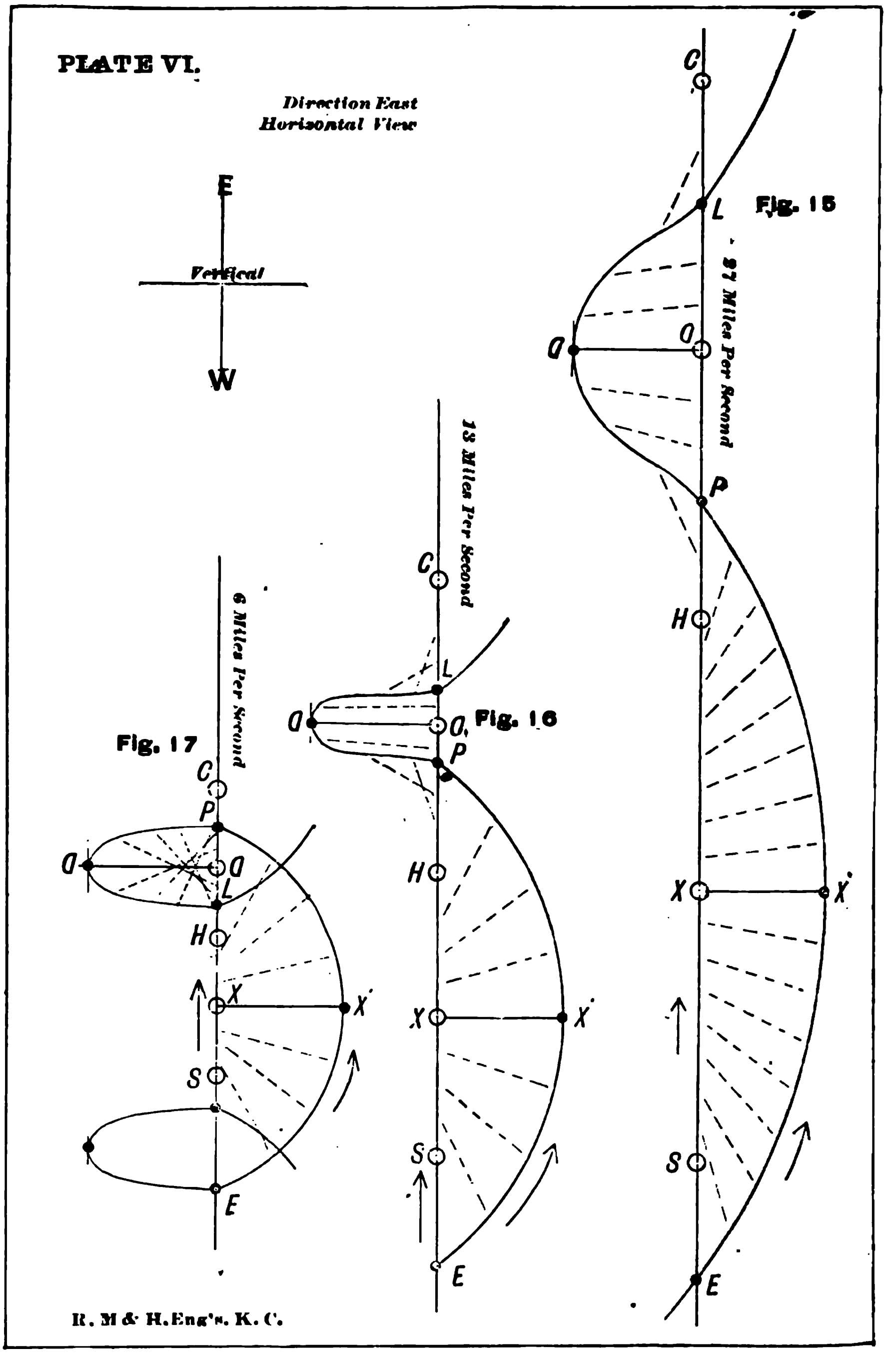


PLATE VI.
Direction East
Horizontal View
E
Vertical
W
Fig. 15
27 Miles Per Second
Fig. 16
13 Miles Per Second
Fig. 17
6 Miles Per Second
C
L
O
Q
P
H
X
X'
S
E
R. M & H. Eng's. K. C.

a line from the Sun to the Earth will make an angle of 23½° on the north side of the equator. Then there is but one point possible for the Earth. It can only be at P.

The equinoxes too are fixed for us, for the plane of the equinoctial colure is perpendicular to that of the solstices. Then the equinoxes are at X and D. At X the Earth is 91,430,000 miles vertical to the Sun. And at D it will be 91,430,000 miles below the Sun. In one year the Sun will be at C. And then the earth will be at L, a position exactly corresponding with E. Year after year we will have this movement repeated. I trust the diagram is understood. The points E and P in the path of the Earth are in our plane. From E to P the Earth moves above, from P to L below, the line of the Sun's path. If the Sun moves in this direction, and at this rate, the earth's movement must be precisely as here shown.

The above description answers for each of the figures on Plates III, IV and V. In each of these we have the same plane, the plane of the solstitial colure; but different movements in the plane. In these figures we have three different rates of movement, and three different directions. The starting point of each is the winter solstice; when the earth is in this plane. And we know the precise point. It is at that point in the plane, where at its appropriate distance from the Sun, a line from the Sun will make an angle of 23½° with an east and west line, our equator. Now this is as definite as lines and angles in geometry can make it. As definite as the surveyor can be with reference to any locality. And the locality of the Earth at the times of the equinoxes is equally definite. At the time of the equinoxes the earth is, and must of necessity be, vertical with the Sun.

Referring again to our diagrams, on Plates III, IV, and V, at these several rates, and in these several directions, the Earth must be as represented at E. The same reasoning applies with regard to the points at P in these figures. The plane of the earth's equator is, and must of necessity be, at right angles to this plane. Hence it is evident, that at the summer solstice, the Earth is farthest south relative to the Sun. This farthest point south must be in this plane; and at such a point, that a line from the Sun to the earth's centre, will make an angle of 23½° on the north side of its equator. If we have the true distance from the Sun, the surveyor can tell the very acre in the universe of space in which this point will be found. And as we know where the Sun will be at the end of the solstitial year, we know that the Earth must be at L; the locations being determined precisely as the points E were determined. In all these figures the Earth in passing from E to P is above the line of the Sun's path, being at X 91,430,000 miles above it; from P to L it is below, being at D 91,430,000 miles below.

Are my positions thus far established? I have proved nothing as to the movement of the Sun. But I have proved that moving in these directions, and at these rates, the diagram shows where the Earth would be at the time of the solstices, and what would be its line of movement in making its revolution. If the astronomer knows anything incompatible with the showing in the diagrams,

then he knows something that proves that the Sun does not move as here assumed.

To diagram the whole solar system moving in any of these directions, and at any of these rates, we have but to give the several planets their respective distances, giving to each such position on this plane, as its time, its distance, and the inclination of its orbit demands. Then find how far the Sun will move at the assumed rate during the revolution of the planet, divide this into four sections, and proceed as in the case of the Earth.

Before passing, a word in explanation of the figures on Plate VI. They are horizontal views of the movement as represented on Plate V. In the figures on Plate VI, E must be regarded as above the plane, and P below it. Imagine you take the figures on Plate V and roll them over toward the south till P is down, and E up, or till X and D are in this plane at X^1 and D^1, and then you have the figures on Plate VI. These figures are interesting in that they show how different may be the movement in making a revolution. Each planet has a figure of its own, some more like one of these, others more like another.

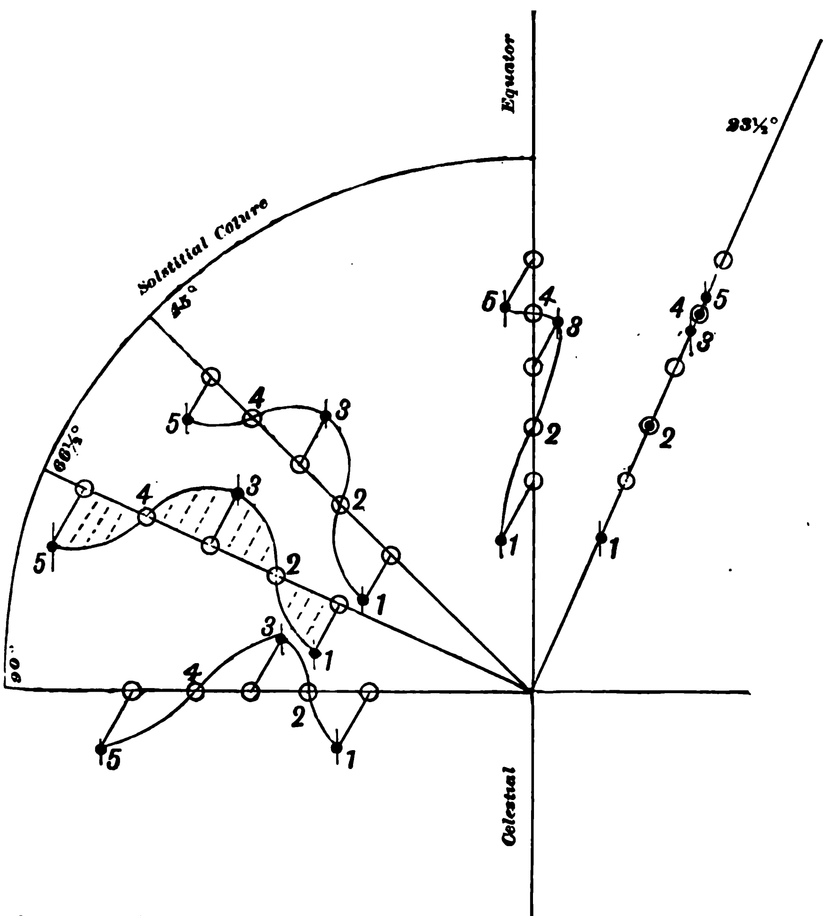
Plates VII and VIII are introduced for the purpose of illustrating principles.

Plate VII is on the plane of the solstitial colure. Plate VIII is on the plane of the equinoctial colure. Comparing the figures on one plate with those on the other, we see the effect of a motion toward different longitude. Comparing the figures on the same plate with each other we see the effect of a change of latitude. The effect as regards the form of coil. The effect as regards the planets velocity. Its velocity as related to the movement of the Sun. Its velocity *at one time*, as compared with *another*. Its real velocity as compared with its apparent velocity. We see under these different conditions, the different methods of producing apparent velocity, and apparent movement. This thing followed up will show that every new hypothesis as to direction, will require a new form of diagram, involving changes affecting all these relations. For example, in the diagram on Plate VII in the direction of 66½° north, the successive revolutions of the earth give us a spiral coil. This is the only direction that will allow of such a coil. Or rather the only line in the heavens, for we may have the same movement on the line, in either direction. It is the only line of movement which will allow the ecliptic to be made up of lines from a succession of parallel planes. It is the only line in the heavens where the earth can possibly, in harmony with known phenomena, keep pace with the Sun, as it advances through space. It is the only line in the heavens that allows of a regular correspondence between the real, and the apparent velocity of the earth, in the several parts of its orbit.

If we believe that constantly acting forces govern every planetary movement, and look after the cause of the onward movement of the planet in the light of our diagrams, we will soon have a decided partiality for some line of movement near the plane of the ecliptic. So here we can study *centrifugal force*, from a new base of observation.

Here we may get a well-defined conception of the ecliptic, as a *plane of rela-*

PLATE VII.

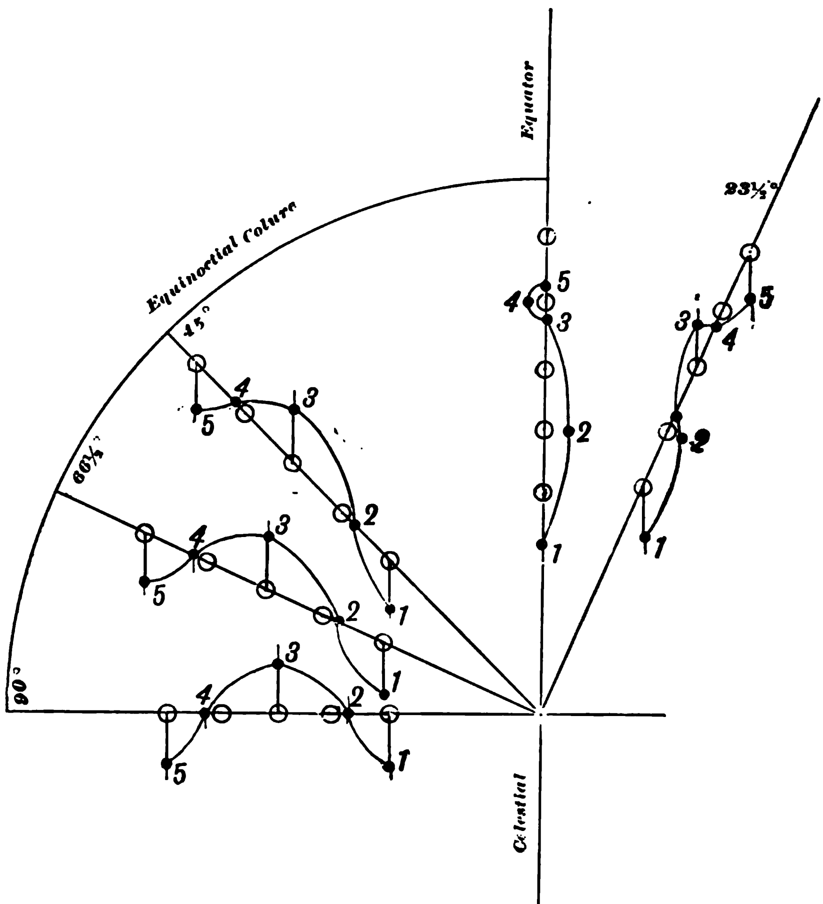


1. Winter Solstice.
2. Vernal Equinox.
3. Summer Solstice.
4. Autumnal Equinox.
5. Winter Solstice.

The points 1, 3, and 5 are in the plane. All other points are either above or below it.

R, M & H. Eng's K. C.

PLATE VIII.



1. Vernal Equinox.
2. Summer Solstice.
3. Autumnal Equinox.
4. Winter Solstice.
5. Vernal Equinox.

The points 1, 3, and 5 are in the plane. All other points are either above or below it.

R, M & H. Eng's. K. C.

tive position. The question as to just how it is formed, will be in a measure dependent on another question, as to the direction of the Sun's movement.

Just here allow a word, to anticipate an objection. It is admitted that computations are more exact than diagrams. But there are things with reference to which computations have nothing to say. All we ask for diagrams, is that they shall be heard where they have anything to say. And this the more, since what they teach is not in conflict, but in harmony with established truth.

We have seen that *in order to harmonize with the phenomena*, any change in the direction of the Sun's movement, must change the diagram,—must change, in other words, the shape of the path of the earth. Remember it is the phenomena that requires this, and not the laws of force. Under the new condition, the law of force would doubtless give us new phenomena rather than new shape to the path of the earth. The new condition would give to the ecliptic a new position. But the phenomena being and continuing as at present, every different line of movement, must give to the earth's path a different twist. And now we must ask the physicist: Will the laws of force and of motion allow of all these twists? Or do these laws, and the phenomena, require of the Sun movement in a definite direction? Here is a problem awaiting solution. What must be the direction, and the rate of the movement of the Sun, in order that, in accordance with known laws, we may have the known phenomena? If we cannot decide this definitely, can we approximate the definite?

The physicist and mathematician may not be able to settle it, but perhaps, there is enough in the vast range of facts, known, and knowable, to definitely fix the only possible direction of the forward movement of the solar system. You may as well talk of a disjointed machine working harmoniously, as talk of the solar system moving as it does, with anything out of place. Much less when the thing displaced is the movement of the master-wheel. The great complication of movement, the laws of force and of motion, will be somewhat rigid in requiring that the forward movement shall be none other than what it is. And the more so, as these laws are to be fulfilled, not only in the movement of the planets themselves, but also in the movement of their satellites. It would be a wonderful instance of accommodation in nature, if, the movement of the planets and of their satellites being just what they are, it made no difference whether the solar system were moving toward one latitude or toward another. We have certain known laws, and we have certain known phenomena; between these laws and these phenomena are certain unknown facts. It is these we are hunting after. The laws cause the facts; and the facts cause the phenomena. By necessity these facts have no wide range of possibility. They are in a strait betwixt two. They must conform to the laws; and they must be in harmony with the phenomena.

We have seen that with different direction of movement on the part of the ruling orb, in *order to conform to known phenomena*, there must be different procedure on the part of the subordinate sphere. This is necessary in order to maintain relation to a certain plane. What is true of the Sun in this regard relative to the planets, will be true of the planets relative to their satellites. That is

to say, any hypothesis that requires the earth to move, in the course of the year, in as many directions relative to the plane of its own equator, as are to be found in the quadrant of a circle, will require the Moon, in order to maintain its position relative to the equator, to make as many contortions as are seen in all these diagrams.

This is about what is required, if the Sun moves toward 47° north. Some one is ready to remind us of "the effect of two forces acting at the same time, in the same, or in opposite directions." Let that apply, where it applies; it has no business here. We have to do here, not with what forces, but with what in a given hypothesis the phenomena requires. If the law of force requires this, all right. But if it is only the phenomena that requires it in a hypothetical case, it is a different matter.

The above indicates why I reject the teaching of the books as to the direction of the Sun's movement.

We have it on high authority that the following is the mean inclination of the orbits of the planets to the plane of the Sun's equator.

INCLINATION OF ORBIT TO SUN'S EQUATOR.

Mercury	1°	18′
Venus	4°	58′
Earth	4°	37′
Mars	2°	42′
Jupiter	5°	28′
Saturn	4°	46′
Uranus	5°	9′
Neptune	4°	59′

If the orbits of the planets cut the Sun's equator at these angles, their paths will cut it at angles much smaller. If you would see this turn to Plate I. In Fig. 2, the line P S being parallel to the earth's equator, the angle E S P is the angle of the orbit with the equator; but the angle E X P would be the angle made by the crossing of the paths of the earth and Sun. If the Sun's path is more nearly in the plane of the ecliptic, as it surely is, the angle made by these crossing paths would be much smaller than as represented in the figure. I will here venture the prediction that it will yet be found that the paths of all the planets cross the path of the sun at an angle of less than two degrees.

Now observe, the orb that attracts the Sun and determines the direction of its movement, also attracts each of the planets, according to my theory even more powerfully, and in good part determines the direction of their movements. The planets would skip off and leave the Sun were it not for his power to hold them in check. "He rejoiceth as a strong man to run a race." If the Sun moved directly toward its ruling orb, all the equatorial planes of our system would coincide; there would be no lateral oscillation in the planets paths; and so, no seasons. Because of these diverse directions, at times, part of the force from both of its superiors tends to bring the planet into what may be called the

Sun's orbital plane; and then momentum carries it beyond. The movement out, on either side, is always from momentum; the movement in is effected by the forces as above explained. Thus the Sun in its revolution in 25,000 years, swings back and forth with reference to the orbit of its superior. Thus the several planets in the times of their respective revolutions swing back and forth with reference to the orbit of the Sun. Thus the moon in the time of its revolution swings back and forth with reference to the orbit of the earth. Thus the satellites of Jupiter and Saturn swing back and forth with reference to the orbits of their rulers. If in all these cases instead of saying orbit, I had said path, it would have been equally true, though orbits and paths are very different things.

The solar system presents many wonderful harmonies; so there is room here for analogical reasoning. As a rule satellites and planets make their revolutions nearly in the plane of their own equators. This would lead us to expect the same of the Sun. As a rule subordinate spheres revolve nearly in the planes of the equators of their primaries. This would lead us to expect that all, the Sun with the rest, revolve nearly in the same general direction. The plane of the moon's equator is south of the earth during one-half of its revolution, and north during the other half. The plane of the earth's equator is south of the Sun during one-half of its revolution, and north of the Sun during the other half. The plane of the Sun's equator is south of its ruler during one-half of its revolution, and north of its ruler (Sirius?) during the other half. The Moon makes its revolutions around the earth in a certain manner. Why should not the earth and and the Sun make their revolutions in like manner?

The forces affecting the Moon cause it to change its position relative to the earth amounting to four right angles in the direction of its own equatorial plane, while they cause a change at right angles to that plane, amounting to four times 1½°. The forces affecting the earth cause it to change its position relative to the Sun, amounting to four right angles in the direction of its equatorial plane, while they cause a change at right angles to that plane, of four times 23½°. The forces affecting the Sun cause it to change its position relative to its ruler (Sirius?) amounting to four right angles in the direction of its own equatorial plane while they cause a change at right angles to that plane of four times — degrees.

Let us look at Jupiter and Saturn; these have systems not unlike the Sun. Jupiter has four satellites. The nearest one revolves nearly in the plane of his equator, the next a little more out, and so the next; the farthest satellites having the farthest range. So of Saturn's rings and satellites. The rings revolve in the plane of his equator; the satellites nearly in that plane; having range from it according to their distances.

So of the Sun , and its subordinates. Mercury revolves nearly in the plane of the Sun's equator, while larger latitude is allowed to the orbits of the more remote planets. All this warrants us in expecting to find the Sun moving in a direction not far from the plane of its own equator. I do not propose to settle with precision either the direction toward which the Sun is moving or its rate of motion. I leave this for the astronomer and the mathematician, neither of which

I claim to be. I believe if they will resort to diagrams and mathematics, astronomers have the data for determining both of these with the utmost precision.

On Plate II we have a representation of the moon in its revolution about the earth. All will admit that the moon makes its revolutions after this manner. May we have some analogical reasoning here? "The science of astronomy had its origin in the study of the moon." Were it not for the moon astronomers would have been left to grope in comparative darkness. It is doubtful whether even the law of gravitation would have been discovered. If the moon has been so useful in suggesting truth in other directions why not look to it for a hint on *the anner of effecting revolutions?* Better do this than make the moon an oddity in the planet family, as some are disposed to do. Surely the moon is none other han a satellite. It makes its revolutions very much as does the outer satellite of Jupiter. So it would appear if seen from Venus or Mercury.

. I must insist that the planets make their revolutions with reference to their ruler, the Sun, very much as the Moon does with reference to its ruler, the Earth, Then, as the Moon only seems to move around the earth, so the planets only seem to move around the Sun. In their movements through space the earth and moon pass and repass each other, thus giving the appearance of movement in an orbit. So, in their movements through space, the earth and Sun pass and repass each other, thus giving the appearance of movement in an orbit. So, I suppose, in their movement through space, the Sun and Sirius pass and repass each other, thus giving the appearance of movement in an orbit. So, like the old astronomers in relation to the earth, we have been taking the apparent for the real. I am compelled to believe that all the spheres of the system are moving in the same general direction: A law of supremacy and of subordination giving to each the path in which it is to move; that in most cases, what we call the orbit is formed, the one half by the faster movement of the subordinate sphere; the other half by the faster movement, relatively, of the ruling sphere. They pass and repass each other, and out of that comes our revolutions.

Some one asks, "What then becomes of Newton and Kepler?" The laws that Newton discovered will take care of themselves. And they will be found to apply nowhere more beautifully than in the theory of movement here presented. As to the first and second of Kepler's laws, they are in a sense true. They are true if you speak only of something which is *apparent*. The first law is, "The planets move around the Sun in elliptical orbits." In the same sense in which this is true of the moon and earth, it is true of the planets and the Sun. Turn to the diagram on the moon's revolution, Plate II, and there define your idea of *moving around*, and of *orbit;* but especially of moving around. There you see in what sense this is true and in what sense it is false. In the primary meaning of these words it is not true. And the *moving* around is as ideal as the orbit. But the law is true of the *relative positions* of the planets and the Sun during apparent revolutions. In *relative position* we have the conditions of an ellipse, a revolution, an orbit.

epler's second law is that "the radii vectores pass over equal spaces in

equal times." Here we want definiteness of idea. To regard this as true of the real movement of a line joining the Sun and planet is very far from the truth. But, if we ignore the movement of the Sun, and ignore the real movement of the planet, and take account of the apparent movement the law is true. That is, it is true of the *angular velocity* of the planet. But its angular velocity is one thing, and its real velocity is quite another. Its angular velocity is never the same as the real. It is sometimes in a direction the very opposite of the direction of the actual movement. As velocity in the prime sense it is all apparent, at certain times.

As to Kepler's third law, the theory of movement here presented enables us to see why "the squares of the times are to each other as the cubes of the distances." We see at once how this law results from two others: the law of falling bodies, and the law of attraction. First, in each quarter of a revolution a certain amount of gain is to be made, viz: the distance of the planet. This gain is to be made by a constant increase, or diminution, of velocity, according to the law of falling bodies—$t^2 = \frac{2d}{g}$. From this we get $t^2 : t'^2 :: \frac{d}{g} : \frac{d'}{g^1}$. But this gain is made according to the attracting force—gravity. And, $g \propto \frac{1}{d^2}$. From this we get the proportion $g : g^1 :: \frac{1}{d^2} : \frac{1}{d'^2}$. Combining these two proportions we have Kepler's third law. $t^2 : t'^2 :: d^3 : d'^3$.

I submit this simple exhibit of *the why* of this wonderful law in confirmation of my position. And I submit in confirmation of my position that here we have all we want in explanation of the cause producing and continuing the momentum —and the centrifugal force. Here it is all explained. I submit in conformation of my position that as the satellites are not so much under law to the equators, as to the paths, and to the orbits of their rulers, we are to expect such a general forward movement as permits a degree of constancy with reference to the paths.

The diagram gives us a new base of observation for studying the cause of the precession of the equinox. Also for studying the causes for the revolution of the perihelion and aphelion; and for *variations* in *apogeal advances* and *regressions*. It gives us a new base of observation for studying the plane of the ecliptic, as a plane of relative position. And as all orbital planes are similar in this respect, we may have a better understanding of orbits, and of forces determining them. It is only where we distinguish the apparent from the real, in movement, and in velocity, that we can rightly estimate the varying momentum which has so much to do in all these matters. The momentum that determines the elipticity of orbits. That determines the direction of the major axis; and that determines the variations of orbital inclinations. And now we are in a better position to look after the law which determines the axes of the planets, and so the equators, and to get a clue to the secret cause of the diurnal revolutions. A careful study of this whole subject, will reveal that none of the revolving bodies move in a plane; but that in addition to the deflection causing the revolution; there is another deflection causing inclination of the orbit of the inferior, as referred to the orbit of

its superior; and this grows out of momentum and attraction, *like the swinging of the pendulum.* For example, whenever the moon gets to either side of the plane of the ecliptic, the tendency of the attractive force, both of the earth, and of the Sun, is to bring it back to that plane. But its momentum causes it to go *so far out*, before it is overcome by these forces. Then it swings back as the result of the attracting forces. Thus this north and south movement is a sort of oscillation. The plane of the ecliptic being to the moon what the gravity-centre is to the pendulum of the clock. In each case we have momentum acting against gravity. Momentum carrying it beyond, attraction bringing it back. And so doubtless in their revolution *all the planets oscillate across the orbit of the Sun.* Astronomers must study the Moon in this light, learning its real and its relative velocity in all parts of its path, before they can fully master the problem of *the causes* of its varied movements. And here they may seen farther than has yet been done into the causes of *nodal regressions, and of their differences at different times.*

Discovery has not yet reached its limit. Nor has the process of eliminating errors in astronomical science yet been perfected. The coming astronomer has a grand field before him.

This paragraph is only added because of the dogged persistence I have seen among certain college professors. They are fond of the old illustration of the man walking around some object on a sailing vessel. One especially likes to illustrate the revolution of the earth around the Sun, by a race-horse running in a circular track, making a revolution around a stake at the center. They find in their books much learned bosh, and it is their habit to give it out to their students. How can it be otherwise when dealing so much with the apparent as though it were real. These illustrations are misleading. The cases are not analogous. To make it analogous, the central stake should have a movement on the surface of the earth, having the same relation to the moving horse, that the movement of the Sun has to the moving earth. Then your race-track would not be circular, but like that given to the earth in these diagrams, Fig. 1. But the learned professor will say, we may ignore all movement except that which is relative. And then, he not only does this, but goes on to *ignore the difference between the apparent and the real.* If pressed somewhat, he finds shelter under the declaration that "there is no such thing as absolute motion." Two students, Brown and Jones, having two yards of elastic cord, attempt while walking, to make a revolution, as the moon does around the earth. Brown represents the earth, and walks in the the middle of the road. Jones represents the moon, and makes the revolution. After walking thirty rods or more, all the time carefully honoring Kepler's laws, with Brown moving on at a steady gait, they have made three-fourths of a revolution. Jones says, "how far have I traveled?" Brown answers, "just three-quarters of a revolution in an orbit with a radius of two yards." But Jones wants to know something about movement over the road. Brown tells him that "in astronomy we ignore the road," that "all movement is relative." Jones is not satisfied. he has certain ideas about the ground passed over. But Brown, like a

good student, tells him "there is no such thing as absolute motion." It is evident that in order to give a diagram of the performance of these two boys we would have to be precise in dealing with the road. Road-measure here would be a reality, whatever becomes of the dogma that all motion is only relative. And if Jones was carried by an external force, which you were trying to understand, it is not likely you would succeed, if you persisted in ignoring space as measured on the road.

If told that the opening among the stars in Hercules shows that the Sun is moving in a certain direction, the answer is that in astronomy the apparent is often other than the real. These openings show a diminution of distance; but how effected, is another question. The man who will study this question in the light of diagrams will not for one moment concede that the solar system is moving in that direction. A difficulty more formidable to the writer arose from the reputed direction of the equator of Venus. All the text-books gave to Venus an inclination of axis, which if true, was incompatible with my theories. I felt obliged, either to surrender much of my ground, or to claim that all the text-books were wrong as to the direction of this equator. Seven years ago, I boldly took the ground that the text-books were wrong, and that the plane of this equator would be found but little removed from that of our own. It was with no little pleasure that in reading the lectures of Prof. A. C. Young delivered last year in New York, I found this declaration with regard to Venus. "As to the direction of its axis we do not know anything. And I say that because you will find it stated in many text-books that the axis is inclined at an angle of some 70° or 80°. I don't think we know that. I am quite sure we do not." So, with me, that trouble is over;though my confidence was such that it gave me very little trouble.

The writer will not be surprised if some errors will be found among the many things here suggested. But he is confident that the main things set forth in this paper will be found true; and that they have an importance far beyond what most people will be ready to ascribe to them. Much that he was disposed to say here has been ruled out, lest damage should come from admitting the doubtful. If this much is established, what is in reserve will naturally follow. For the most part, its unfoldment will require more mathematical knowledge, and astronomical research, that the writer has attained to. The whole is given over to the builders of the new astronomy, with assurance that some coming man will crown himself with honor by a farther pushing out in these directions. That man has my benediction.

ENGINEERING.

THE IMPROVEMENT OF THE MISSISSIPPI RIVER. — BOTH SIDES OF THE QUESTION.

I. THE LEVEE SYSTEM.—At a late meeting of the St. Louis Civil Engineers' Club a paper upon "Protection of the Lower Mississippi Valley from Overflow," was read by Mr. J. B. Johnson, of which the following is an abstract:

The extent of the overflowed region is 20,000 square miles. The great floods always come out of the Ohio in the early spring, and are likely to increase in size and frequency as the country becomes more generally cleared and drained. There were five parties in the field for the River Commission taking daily observations for discharge for the whole of the year 1882, four of which were below Cairo. The results of these observations are now published, together with observed discharges over the banks and through the swamps for the flood of that year. If all the overflow water had been confined to the channel, the channel discharge would have been increased on the upper portions of the St. Francis front by 12 per cent, along the central portions by 50 per cent, along the lower portions and upper part of the Yazoo front by 25 per cent, along the central portions of the Yazoo front by 90 per cent, in the vicinity of Vicksburg by 25 per cent, at Red River by 20 per cent, and at New Orleans by 100 per cent of the amounts that actually did pass in the channel at these points.

Four methods of treatment were presented:

1. To have no levees whatever and let the water find such natural outlets into the swamps and finally into the Gulf as nature had provided. This method of treatment would result in the abandonment of this region by the better classes, since agriculture could not be made profitable. It was thought, however, that with the present excessive variations in the width of the channel this method of dispersion was really in the interest of low-water navigation. The gist of the argument on this question seemed to be that since the bars are all formed at high stages, and the higher the stage the higher the bars are built, so, any addition to the high stages by means of levees increases this bar-building influence. In high stages the river always scours in the deep places and fills on the shoals, which is exactly the reverse of what is desired.

It was shown that the bars were caused by the inordinate variations in the velocity of the water at successive sections, owing to the great changes in width. Bars are wholly formed by the deposit of sand which had been in temporary suspension for a few miles, coming from the first deep pool above. The variations in velocity, causing these deposits, are enormous, being on the Plum Point reach much as 6 feet per second (from 10 feet to 4 feet mean velocity). The remedy n contracting the channel in the wide places and not in building levees.

The second systen of protection is that now in vogue, or levees high enough to hold ordinary floods, but great floods always breaking through them. This is both expensive and unsatisfactory. It is a protection that costs millions of dollars and yet does not protect.

The third method is to build the levees high enough and strong enough to stand the greatest flood that would likely come upon them. As to the heights the flood would have reached had the water all been confined to the channel, the estimates of Gen. Comstock, President of the Mississippi River Commission, were taken and are as follows:

At Columbus, Ky., there would have been added 200,000 cubic feet per second to the channel discharge, giving an increased height of three feet. At Fulton, Tenn., with 600,000 cubic feet to be added, the increased stage would have been 10 feet. At Helena 360,000 cubic feet would have been added, giving an increased stage of four feet. At Lake Providence the discharge of 1,000,000 cubic feet would have been nearly doubled, giving an increased stage of 10 feet. At Red River Landing there was 1,600,000 feet passing in the main channel, 300,000 cubic feet passing in the Atchafalaya, and 300,000 more passing overland. If this amount of overflow water were divided proportionately between the two streams it would raise them both three feet.

At New Orleans the maximum discharge was 900,000 cubic feet per second. If the discharge at Red River of 1,600,000, increased by 200,000 cubic feet of overflow water, were all confined below that point the discharge at New Orleans would be doubled. The increased height of the water is somewhat uncertain, but it would probably be about 10 feet.

The mouth of Red River is probably the head of the Delta, and an effort now to confine all the water to one or two channels will demand enormously high levees. And yet Captain Eads resigned his place on the commission because they declined to close the Atchafalaya entirely, and so deprive that part of the river of this partial relief. The increase of stages given are all so much above the high-water marks of 1882.

Levees calculated to confine the greatest floods must be on an average sixteen feet high where there are now none, and all levees now built must be raised on the average by eight feet. The cost of a proper levee is $50,000 per mile, which means a total expenditure of some $50,000,000 to confine such a flood as that of 1882 to the channel from Cairo to the Gulf, allowing, also, the Atchafalaya to discharge its full capacity.

The River Commission has estimated $11,000,000 for this work. This low estimate is the occasion of Gen. Comstock's exceptions to the report.

The third method of protection is more feasible. The features of this system are moderate-sized levees, or such as will keep out all moderate or ordinary floods, or such levees as are now found. Provision made for the discharge over these levees of the excess over the channel's capacity, in case of high floods, without injury to the levee, and provision for the conveyance of this flood overflow back to the channels of the bottoms. Levees of this size would probably furnish com-

plete protection four years out of five. When they are insufficient, the excess must be allowed to pass the line of the levee by weirs with revetted slopes, so that the water can be safely transported without injury to the levee. This system has been succesfully employed in France. To discharge 1,000,000 cubic feet per second with a three-foot depth on the weir would require a weir about eleven miles long. The weir must be located where the facilities for carrying off the water are best, or in the vicinity of the old natural outlets from the channel to the swamps. There are many such natural outlets, some of large size, such as the Yazoo Pass. These would only required to be cleared and they would then enlarge, as the Atchafalaya has done, and so this overflow water might be transported away from the river bank without flooding the plantations. When the water escapes over the banks now it must find its way through tangled forests and canebrakes as best it may, and the result is it rises till it includes all in one vast inland sea. and stands as high behind the levee as in front of it. This method of protection is deserving of the attention of the Commission and should be carefully studied.

II. THE OUTLET SYSTEM.—Capt. John Cowdon, of New Orleans, whose name has been made prominent as the projector of the Lake Borgne outlet plan, for the improvement of the low water navigation of the Mississippi River and tributaries, and the reclamation of the valley lands from overflow without the use of levees, spent several days last month in this city in the interest of his projected enterprise. He holds that Kansas City, being in direct communication with the Mississippi River below flood lines via the Kansas City, Springfield & Memphis Railway, has more commercial interest in the success of the Lake Borgne outlet than any other western city, and on his way from New Orleans here was particularly struck with facilities of the Memphis line as a medium of commercial communication between Kansas City and the Mississippi River.

We condense his views as given in the Kansas City *Journal*:

He regards this road as the most important one for this section of the country ever built, for the reason that it, more than any other route of transportation, penetrates the Southern States, striking the Atlantic Ocean at Brunswick, Ga., and crossing the Mississippi River below the ice gorge and shoal water, and when the Mississippi may be opened with a thirty-foot channel that ships can find, it will require two double track roads to do the business that will then seek the Southern commercial outlets.

A considerable portion of this road runs through the bottoms and overflowed lands of the Mississippi, and, not only the St. Francois bottoms are overflowed but the entire valley, from Cairo down to the Gulf, rendered comparatively worthless. If authority can be obtained from Congress during the short session to make the Lake Borgne outlet at private expense, asking nothing of Congress until the work is accomplished, it will reclaim that entire valley from overflow the first year, and the value to the Kansas City and Memphis road alone would be hundreds of millions of dollars.

To show how the outlet plan would operate he referred to some engineer-

ing facts obtained from the highest authority in this country, which show the absurdity of all other plans and the feasibility of this one. General Humphreys, the old chief engineer of the United States Army, who spent ten years examining the Mississippi River, making the most elaborate report ever made by any one, says that the approximative fall from Cairo to Memphis is five inches to the mile, for a distance of 200 miles, while we all know that the current is fully five miles per hour. For the last 200 miles of the river (from the mouth up) the approximate fall does not exceed two inches to the mile and the current is only about three miles an hour. This of itself shows that the water runs in faster at the upper end of the river than it runs out at the lower end, and the more levees they build the less angular fall per mile, which in consequence makes the water run slower and is the real cause of overflows. Upon the same principle, the more levees the greater the overflows.

By the plan of the Lake Borgne outlet the flood waters of the river reach the Gulf in going five miles instead of 120 miles farther by the natural way of the river, which will lower the flood line at New Orleans in the course of a couple of years, or in other words will restore the same condition of water levels at that point as when the mouth of the river was there, which was fully fourteen feet below the present flood line. As a natural consequence this will restore the flood lines of that period all the way up to Cairo, which were from twelve to twenty feet below the present flood lines, doing entirely away with the necessity for levees, and at the same time, confining within the natural banks of the river the waters of the entire valley, which will in high as well as low water wash out its bottom, confine the water and deepen its channels. The trouble is with all of these educated scientists, they appear to never have understood in this great problem that there was a Gulf of Mexico, the only place capable of emptying the Mississippi River, or they certainly would have considered the necessity of getting the flood waters of the Mississippi River and valley into the Gulf by shorter and quicker routes than by the natural course of the river itself.

By this plan the waters of the river are confined, while the River Commission maintain that they spread out and overflow the country. But they don't understand the difference between an outlet and a crevasse, for if the Lake Borgne outlet is made there will be no crevasses, and if there are no crevasses there will be no overflows. For an outlet, such an one as Lake Borgne, takes the floods from river direct to the Gulf and relieves the river of all its flood waters, while on the other hand a crevasse is a place where the levees break, flooding the back country and returning to the river again at some point below, affording no general relief.

The closing of Bonnet Carre crevasse raised the water in the river higher than ever before at New Orleans and in the lower section of the river, and the relief was only found by the breaking of a levee on the west bank of the river between New Orleans and Bonnet Carre which overflowed the parishes, causing a loss of fully $10,000,000, ruining a great many people and rendering their land incapable of producing a crop for another year. All this loss of property has

been caused by the River Commission and its friends who want to close all outlets and build levees.

The consummation of the outlet plan upon New Orleans would be that in the first place it would drain the entire valley from overflow, giving that city the products of nearly all the land in the valley below Cairo, which would amount to hundreds of millions of dollars annually. Second, the flood line of the river being lowered fully fourteen feet it would make that city high and dry, and render a system of sewerage possible which would entirely free that city from yellow and malarial fevers, which would do away with the quarantine except as at other cities, which now operate detrimentally to her commerce. When New Orleans is properly sewered and has such sanitary regulations as other cities enjoy, the yellow fever and other epidemics will not spread there any more than in New York and other northern cities. There is no doubt that New Orleans has degenerated very greatly within the past twenty-five years as a commercial centre, as compared with other cities, owing to her epidemics and her lack of a deep outlet uo the sea. As an evidence, in 1860 the cotton crop of the United States was 3,200,000 bales, of which New Orleans handled 2,200,000 bales. The crop now is 6,500,000 bales, of which New Orleans does not handle to exceed 1,700,000 bales. Then of the tobacco crop produced in the country in 1860, New Orleans handled 88,000 hogsheads, and now, when the crop is fully three times as large, she does not handle 10,000 hogsheads. Then in 1860 New Orleans imported 22 per cent of the entire imports of the United States, while at present her imports do not exceed 2 per cent. At that time New Orleans imported 80 per cent of the coffee consumed in this country, and now out of 200,000,000 pounds imported annually she handles less than 20,000,000 pounds.

"As another fair illustration of this decay, when I was in New Orleans a few days ago I saw but two steamers loading for foreign ports, and but three or or four sailing-vessels at the wharves, while twenty-five years ago I have seen 200 sailing-ships and from fifty to 100 steamboats at the landing at one time load- and discharging cargoes from all portions of the world. Now there are to be seen only a few local packets. The fact is that fully 90 per cent of the commerce of the Mississippi valley which should go to New Orleans now goes off east by the railroads. The people of the great northwest and especially of Kansas City, are as deeply interested in the prosperity of New Orleans, the reclamation of the valley lands of the Mississippi; an improved river and opening of a deep outlet for your commerce to the Gulf as are the people of that city and valley themselves. For with these things accomplished it will place your grain in Liverpool for fifteen cents per bushel, while it now costs you thirty cents to New York, and this in a nut-shell explains the reason why so many plans are adopted in order not to improve and open that river, and is the secret of all the opposition to what we propose to accomplish by the Lake Borgne outlet and auxiliary work."

EDUCATION.

TECHNICAL INSTRUCTION IN EUROPE.

F. G. FRENCH.

(*Translated from the German of Dr. Herman Grothe.*)

The various efforts made at the present time to educate the young in some skilled handiwork have led the German Society for the Advancement of Industries (Verein zur Beförderung des Gewerbefleisses) to establish a commission with the object of inquiring what branches of industrial training are carried on in the different special schools, and workshops connected with schools, in Germany and neighboring countries. The following is taken from the report of Dr. Hermann Grothe, Honorary Member of the "Central verein der Deutschen Wollenwaaren-Fabriksanten," on the subject. In France an intermediate grade of industrial training is given at the Schools of Arts and Trades at Chalons, Aix and Angers. These three schools have regular workshops and rooms enough for 900 pupils.

Lately several industrial schools or higher commercial and industrial schools have been started. For instance at Limoges there is a school of ceramics; at Lille one for spinning and weaving of linen; at Nevers one for iron-work; and at Roubaix one for weaving. The Central School of Arts and Manufactures and the Conservatory of Arts and Trades in Paris give a higher grade of technical instruction. In addition to the national special schools for this grade of work there are in France numerous communal and private institutions of a similar character, such as the Delahaye Institute, the Springer Institute and the Communal School of the Rue Tournefort in Paris, and the Institute of Our Ladies at Nantes. The Martinière school in Lyons belongs to a still lower grade. This one, with some other schools of arts and trades, or higher commercial and industrial schools, is in part preparatory to the State institutions. Several schools have now a special organization, thus the National School for watch and clock-making at Cluses, the School of Textile industries at Epinal, the Higher Industrial School at Rouen, the Industrial Institute for Flax-spinning at Lille, the School of Industrial Arts at Roubaix, the Weaving School at Lyons, the Lace-Work Schools at Dieppe, Creuzot, Bayeux, St. Brienne, etc., that for willow-culture and basket-weaving at Origuy-on-the-Thou, those for stone-cutting at Clermont, Ferraud, Grenoble and Neinlly-on-the-Seine, with others for cabinet-making, furniture manufacture, type-setting and paper-making. Certain orphan asylums also have workshops connected.

In Belgium there are no institutions for technical education of a secondary grade. But in 1879 there were thirty-two industrial schools reported which

aimed to give working-men a higher theoretical education. There were also fifty-nine workshops for apprentices, and numerous drawing-schools.

In Italy the government has seen to the establishment of over fifty work and industrial schools (scuole professionale, industriale.) These have 20,000 pupils, are situated in rural districts, and receive aid from the Ministry of Agriculture and Commerce. There are also art schools for drawing and modeling, several professional schools for women, and many advanced schools and private institutions under the charge of certain societies. For higher technical instruction there are regular technical institutions, some provincial, others communal. Among these are naval and technical schools in sea-port towns. At the exhibition in Milan in 1881 there were sixty-seven of these making some exhibit.

The Netherlands report professional schools (Ambachtscholen) at Amsterdam (since 1861), Rotterdam, Arnheim, the Hague, Groningen and Utrecht. Among higher grade institutions are the Machinists' School at Amsterdam, and the Academy of Arts and Sciences at Rotterdam.

In Spain the elements of agriculture, the arts and industries, commerce and seamanship are taught. The higher technical schools cover engineering in all its phases, and there are six land-surveying schools.

Portugal had up to 1873 only two theoretical-technical schools—at Lisbon and Oporto. In connection with the latter was a workshop for mechanicians where the most accurate instruments were tested. The death of Fradesso da Silveira, Director of the Polytechnic School at Lisbon, put a stop to any reforms in that institution.

In Russia higher technical schools are represented by the technical institute —dating from 1825—at Moscow; the Institute of Technology at St. Petersburg, which dates from 1831; the Technical School at Helsingfors (1847); and the Polytechnic—from 1861 or 1862—at Riga. There are also many institutions, with workshops attached—for a lower grade of industrial training. The Polytechnic museum at Moscow, and certain industrial art schools come into the list of technical departments. The Polytechnic School at Riga, which is organized like similar institutions in Germany, had about 700 students in the summer term of 1884. Thirty-six followed the course in architecture, 175 that of mechanical engineering, and 183 the chemical-technical course. The income at present is 45,000 roubles (65.8 cents to the rouble). A new and large laboratory is now in process of erection. The professors are about equally divided between home and foreign talent.

In Sweden and Norway efforts are being made to advance the educational status of laborers and workingmen generally, by means of handiwork and needle-work schools. Household industries are also taught in evening and Sunday schools. At Gothenburg there are twenty-one workshops where 1,600 children are under instruction, and near the city is an extensive manual training school. In Stockholm household industries are taught in connection with the common schools. Nearly all the cities of Sweden have schools in which industrial training is given.

Denmark has a Polytechnic Institute at Copenhagen, as well as a school for a lower grade of technical instruction. Since 1873 numerous handiwork schools have been started at the suggestion of Clauson-Kaas.

Switzerland gives a high grade of technical instruction at the Polytechnic School, and a lower grade at several industrial institutions where, however, there are no workshops. Several handiwork schools are also reported.

Austria-Hungary has technical schools at Vienna, Prague (2), Brünn, Gratz, Lemberg, and Pesth. The national technical-industrial schools are all fully equipped special schools. Among the secondary technical institutions the technological museum in Vienna holds first rank. The special schools which receive State aid are very numerous. There are namely twenty-nine for bobbin-lace work, embroidery, lace-making, and weaving; twenty-two for wood and stone-work; six for ceramics and glass industry; seven for working in metals, and five for different kinds of work—in all sixty-nine.

Germany has higher technical institutions in Berlin, Hanover, Aix-la-Chapelle, Dresden, Münster, Stuttgart, Brunswick and Carlsruhe. The twenty-four provincial industrial schools established by Beuth in Prussia have come to naught. In Barmen a high and lower grade technical-industrial school was founded in 1863. At Crefeld a higher textile school was established. In Remscheid and Iserlohn there are special schools for metal and bronze-work, in Montaban near Wiesbaden ceramic schools, in Heinsberg (Aix-la-Chapelle) workshops for basket-weaving, in Glashütte a watchmaker's school. There are also several private building schools and advanced schools (Baugewerk schulen and Fortbildungs schulen); in all 213 technical-industrial schools.

An institution for general industrial training at Hamburg has a school for builders connected with it. Saxony possesses industrial art schools in Dresden and Leipsic, twenty weaving (Web und Wirkerei) schools, thirty-one lace, needle-work and embroidery schools, three for spinning, two for wood carving and working in wood generally, three for straw-plaiting, one for lead-workers, one for instrument-makers, one for watch-makers, two schools of music, four ship schools, and numerous drawing-schools. Middle grade technical-industrial instruction is given in five schools for foremen (Werkmeister schulen), and in a higher grade technical-industrial school in chemistry. A still higher class of work is found in the Polytechnicum at Dresden. The Duchy of Saxe-Coburg-Gotha reports builders schools at Gotha and Coburg, and basket-weaving schools or workshops scattered throughout the Duchy. Greitz and Gera have schools for weaving, Brunswick an important school in connection with the Society for the Advancement of Industrial Arts. At Holzminden there is a builder's school (Baugeewrbe-schule). Schwerin has a similar school, and Mecklenburg has a fishing-school at Wismar.

Wurtenburg carries on industrial training by means of itinerant teachers, various societies, a central organization, and in 153 industrial review-schools. Baden gives a high grade of instruction in the polytechnicum at Carlsruhe, and a lower grede in forty-four technical-industrial schools. At Carlsruhe there are

both industrial-art and architectural schools. The Grand Duchy of Hesse has forty-eight handiwork-review schools, a school of architecture or builder's school, and a polytechnic school at Darmstadt. Bavaria has in connection with her industrial-review schools 251 vacation schools, also forty-five district industrial schools and many special schools. Higher middle-grade instruction is given in four Industrie schulen. Alsace-Lorraine gives technical training at Mühlhausen, while Strasburg has a winter school for architects, and a skilled handiwork school.

HISTORY.

LOUISIANA—HOW LOST TO THE FRENCH.—A Sketch.

OSCAR W. COLLET.

The old French and Indian war, begun in 1754, intimately effected the destiny of Louisiana, although her soil was not invaded. As one of its results the Valley of the Mississippi was dismembered and the west half thrust upon Spain—an unwillingly accepted gift. Nova Scotia and Canada, the vallies of the Ohio and Mississippi, and the lands of far west, even to the shores of the South Sea, as they called the Pacific, belonged to the French, or were claimed as theirs. To protect what they actually possessed and support their pretensions, to secure safe intercommunication between the north part of their possessions and the south, and constrain the English to confine themselves to the eastern slopes of the Alleghany Mountains, a series of defensive works was designed, extending from the Mississippi to the Lakes.

Land hunger on the part of the English, large grants north of the Ohio, restlessness of backwoodsmen, the eagerness of the rivals to monopolize the fur trade, and national antipathies and prejudices, mutually fostered, were among the causes of this war—a war so destructive in the event to the interests of one of the combatants.

Unity of direction, concentration of population at a few points, military spirit and military habits, and the friendship of the Indian tribes who inhabited the western wilderness were on the side of the French, though inadequately compensating for the disparity of numbers between them and their rivals. All told, their continental possessions contained scarcely sixty thousand souls, whereas the English colonists were estimated at more than a million, besides their alliance with the Iroquois, the most formidable by far of all the northern savages, and especially favorably situated to co-operate in any movement directed against Canadian posts, or the regions of the upper Ohio River.

The English who ventured westward were seized and imprisoned; the Vir-

ginians resented the act, dispatched forces across the mountains under Washington, who at first was successful and then forced to capitulate. Fort Duquesne was built where Pittsburg now stands. Braddock arrived in 1755 with an army, and with auxiliary troops marched westward to attack the Fort. Expeditions against Crown Point and Niagara were planned. Nova Scotia was invaded, the Acadians were overcome and ruthlessly transported to different points in the English colonies. Braddock was defeated with great slaughter. The expedition against Niagara was unsuccessful, that against Crown Point more favorable to British aims.

War was formally declared in 1756. Oswego was taken by the French.

In 1757 Fort Henry capitulated to Montcalm, and the victory secured him complete possession of Lake George. The general result at the close of the year, although large reinforcements had arrived from England, was disaster and defeat.

In 1758 the influence of William Pitt at the head of the British Government was felt in America, and the English commandant, General Abercrombie, was enabled to count upon an aggregate force for the prosecution of the war, of 50,000 men, two-fifths of whom were colonial troops. Three expeditions were planned, against Louisbourg, Ticonderoga and Crown Point, and Fort Duquesne. The first was taken; the second successfully resisted; and the third, after some temporary advantages over General Forbes, who led the attacking column, was abandoned and burnt. The new post that arose upon its ruins was thereafter known as Fort Pitt.

In 1759 Ticonderoga and Crown Point were evacuated by the French, and Sir William Johnson captured Niagara. Wolf attacked Quebec, was killed, as also its defender, Montcalm; the city surrendered.

Face to face the giants stood, a death struggle at hand, an empire to be lost or saved. Note the contrast.

England was governed by the greatest and most masterful of all the distinguished ministers she had ever had, who wielded the resources and the power of a mighty empire with firmness, and vigilance, and vigor, and undaunted perseverance, to the crushing of a rival nation, to this end sacrificing all else and constraining all interests to contribute.

On the other hand, France was under the rule of the miserable Louis XV, as degraded a prince as ever sat upon a throne, whose ambition a new mistress, whose aim in life the gratification of lust, whose companions gilded harlots, whose estimate of money its power to minister to groveling pleasures. Little cared he for success or failure, victory or defeat, honor or dishonor, so long as his ignominious enjoyments were not interfered with; and the revenue of his kingdom, which should have been husbanded to sustain the mighty contest in which the nation was involved, was wasted upon minions that pandered to his vanity, fattened on his vices, took part in his orgies, or gave up their bodies to gratify animal passions so vile and so fierce as to increase with indulgence and know no satiety. Such a thing deserved not success.

In 1760 the combined English force laid siege to Montreal; and in September the stronghold capitulated. The fall of Montreal practically ended the war, as its surrender carried with it that of all Canada, including the posts and forts within her jurisdiction, and left Louisiana at the mercy of the conqueror.

The peace of 1763 terminated ingloriously the continental domination of France in North America. Her feeble grasp was relaxed of a domain the most remarkable, the most valuable, and the most extensive any nation ever possessed since the universal empire of all conquering Rome. The Canada that was known, the northern streams and lakes and the lands they watered whose extent had not been measured by discovery, the vast territory beyond the Mississippi to the far-off ocean, the Louisiana that Marquette had given to France and LaSalle explored, of itself a noble heritage for generations unborn, were lost forever.

The causes of this overwhelming disaster that lie on the surface were: *First*, the relative position of the contestants; a huge semi-circle would roughly represent the line circumscribing their respective countries—the English inside, the French on the circumference. *Next*, disparity of numbers, nearly twenty to one in favor of the British. *Third*, the energy and activity of the English Government which sent large reinforcements to the colony and urged on the war with a determination to overthrow their opponente forever, whereas but feeble aid was sent by France. *Fourth*, the wretched system of government imposed upon Louisiana, and the policy of the mother country in her regard, from the very start, under which it would have been a marvel had she prospered and grown strong, and been in a condition to organize formidable flank movements in time of need, against the western borders of the adjacent colonies.

Looking at results in the light of more than a century's experience, suggests the thought that possibly it would have been better had France either been completely triumphant and possessed the land exclusively with an abundant population, or never attempted to colonize the wilds of the West and South; for somehow the Franco-Canadian population found in the valley when the French domination ceased, and later when the trans Mississippi regions were purchased by the United States, has seemed rather overwhelmed by numbers, than absorbed or assimilated by the dominant race. It has maintained its individuality in manners, and customs, and spirit, and to some extent its native tongue; and its ideas and its life seem to lie outside the Hiberno-Teutonic-Anglo-Saxon population which in this century has spread over the land.

For the monuments of the ancient population we look in vain. Where, undispersed, it still vegetates in a few villages, chiefly along the water-courses, founded long ago, it is as its ancestors were when the Bourbon flag was lowered at the citadel of Fort Chartres—unchanged, impassive, a complete stranger to our nineteenth century ideas. A hundred and twenty years have passed, but it has stood still. It has enriched geography with names, and history with events, but suffered its missionaries and its martyrs, a noble band and its noblest representatives, to lie unhonored in forgotten graves, and the memory of its heroes to slumber uncared for in the chronicles of the past; and even as to these,

if Marquette, and Joliet, and LaSalle, and Bienville, and St. Ange, and others are not as dim and shadowy forms, it is not the primitive population of the valley that has revealed them to us as realities. If we look abroad over the face of our earth where men congregating have formed towns and cities, what is there that witnesses to the presence of the race, either collectively or individually, that once possessed the land and still lives in its descendants. Their memorials may be counted upon less than the fingers of one hand. With not one single important work of education, art, science, culture, benevolence, or religion are they associated. Rich or poor they acknowledge no claim upon them as citizens in regard to such works, and pass them by with indifference as matters in which they have no concern.

Franco-Canadians discovered the Valley of the Mississippi, missionaries of the cross of their race led the vanguard of civilization into its savage wilds to dispense the blessings of religion to the red man and the white, and nature offered the advantages of a fertile soil, genial and diversified climate, and suitable waterways for commerce, with a lavish hand. An energetic population and good government were all that were needed that a grand empire should arise in the midst of the wilderness. But the rule of the Bourbon weighed heavy upon the land, and those that came to make it their home seem not to have brought with them the native qualities which characterize their race on the other side of the sea.

ST. LOUIS, MO., September, 1884.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The record of meteorological observations for the month ending September 20th shows a continuance of conditions very favorable to agriculture. The last decade of August and the first of September were comparatively dry and by the 19th of September the streets in this vicinity were more dusty than at any previous time this year. A heavy shower on the morning of the 19th gave 2.29 in. of water. It is interesting to note that nearly all the heavy rains have occurred in the periods from midnight to sunrise this year and have come from northerly directions. At this date the foliage retains nearly all the freshness of midsummer, and the grass and weeds of late growth have had a remarkable development, owing to the long-continued abundance of rain.

The usual summary by decades is given below.

Temperature of the Air.	Aug. 20th to 31st.	Sept. 1st to 10th.	Sept. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	59.	62.	48.	53.
Max	94.	93.	94.	94.
Min. and Max	81.	77.	71.	76.
Range	35.	31.	46.	37.
Tri-Daily Observations.				
7 a. m.	69.7	73.8	61.0	68.2
2 p. m.	85.3	90.3	84.7	86.8
9 p. m.	71.8	75.7	66.1	71.2
Mean	74.6	79.9	70.6	75.4
Relative Humidity.				
7 a. m.	.81	.	. .	. .
2 p. m.	.52	. .	. .	. .
9 p. m.	.84	. .	. .	. .
Mean	.74	. .	. .	. .
Pressure as Observed.				
7 a. m.	29.080	28.902	29.140	29.041
2 p. m.	29.042	28.875	29.089	29.002
9 p. m.	29.064	28.912	29.100	29.025
Mean	29.062	28.896	29.109	29.023
Miles per Hour of Wind.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles	2547	3658	2608	11718
Clouding by Tenths.				
7 a. m.	6.4	4.0	3.7	4.7
2 p. m.	3.9	2 4	3.7	3.2
9 p. m.	4.0	2.4	2.5	3.0
Rain.				
Inches	1.90	.19	2.33	4.42

BOOK NOTICES.

North American Aborigines. Report of the Peabody Museum, 1881.

It is gratifying to see that the latest report of the Peabody Museum of American Archæology and Ethnology is paying much more attention to the description of living nations and tribes than to the enumeration of the implements and classification of the dry bones of extinct and *nameless* populations. The study of *living* tribes is the principal key for archæologic research, and ought to be pursued with might by us as long as there are any genuine Indians living in North America. Archæology can never become a real science, unless we are enabled to assign the *true date* and *nationality* to the relics and finds stored up in our museums, and this aim can only be reached, if attainable at all, by studying the aborigines of our days. Impelled by this consideration, the author who furnished ---e articles for the 16th and 17th Report (Cambridge, 1884,) before us, has en- ·ed to transmit the impressions, as graphically as possible, which she received

among the Omaha and a part of the Sioux Indians. Miss Alice Fletcher has sketched in this manner the white buffalo festival of the Hùnkpapa, the elk mystery of the Oglála, the cult of the Four Winds among the Isángti, the ghost lodge of the Oglála and the pipe-dance of the Omaha. An article chiefly due to historic research is "on the social and political position of woman among the Huron-Iroquois tribes," by Mr. Lucian Carr, Assistant Curator of the Museum.

A. S. G.

COMPARATIVE VOCABULARIES OF THE INDIAN TRIBES OF BRITISH COLUMBIA: By Dr. W. F. Tolmie and G. M. Dawson. 8vo., pp. 127.

As the first result of activity shown by the newly organized ethnologic section of the geological survey of Canada, Alfred R. C. Selwyn, Director, an instructive publication has just been issued at Montreal under the title: "Comparative Vocabularies of the Indian Tribes of British Columbia," with a map illustrating distribution; by Dr. W. F. Tolmie and George M. Dawson, pp. 127, 8mo. Dr. Tolmie has been a resident in the northwest almost continuously since 1833; for many years he was in the service of the Hudson's Bay Company and through it was brought in contact with a large number of Indian tribes. Dr. G. M. Dawson is well known as a geologist, first by his report on the Queen Charlotte Islands (1878–9). The vocabularies embodied in the pamphlet before us number about thirty and were for the larger part collected by the two scientists in Victoria during the winter of 1875–6; with the exception of the Tinné and Haida dialects and the Kútenay, they embrace about 210 words each (the list of G. Gibbs), and are worded in an alphabet, of which the elements are explained on page 10. Some of the northwestern dialects, especially those of the Tinné stock are exceedingly difficult to render graphically unless the linguist has become previously familiar with them. The vocabularies contained in the volume are the following, the group to which they belong being premised to each group:

THLINKIT: Skut-Kwan.
TSIMSIAN: Kitunto, Kithătla.
HAIDA: Kaigani, Masset, Skidegate, Kumshiwa.
KWÁKIUL: Haishilla, Flailtzuk, Kwiha, Likwiltoh, Kowmook (or Tlathool).
KAWITCHIN: Snaraimu, Songis, Kwantlin.
A'HT: Kayukw-a'ht.
SELISH: Sinahomish, Staktamish, Lilloet, Kalispelm.
TSINUK: Tsi'nuk—proper, Tilhiluit.
BILHOOLA: Nuthlăkimish.
TINNÉ: Tshilkotin, Nakuntlán, Takulli.
SAHAPTIN: Klikatat (or Whulwhaipum).
KUTENUHA: Upper Kutenúha.

This division is carried through the whole volume and also figures in the ethnographic map added to it. It correctly divides the tribes into groups, but if a purely linguistic division had to be attempted, the Kawitchin, Selish and Bilhoola would have to be united into *one* family.

A. S. G.

THE ORIGIN OF SPECIES: By Charles Darwin. Complete in two parts, 30 cents each. J. Fitzgerald, Publisher, 20 Lafayette Place, New York. For sale by M. H. Dickinson.

Darwin's great work, which has revolutionized the whole world of science and philosophy, is now for the first time published in a cheap edition, and brought within the reach of all readers. The present edition is printed in clear type on strong papér, and makes about 260 octavo pages, in double columns, containing the entire work as revised by the author shortly before his death, with the valuable glossary of scientific terms and the very detailed index. The work should be in the hands of every intelligent person who is interested in the current of modern thought.

THE CHILDHOOD OF THE WORLD: By Edward Clodd. No. 60 of the "Humboldt Library of Science." Price 15 cents. J. Fitzgerald, Publisher, 20 Lafayette Place, New York. For sale by M. H. Dickinson.

"The Childhood of the World" is a simple, lucid account of the origin and development of civilization, tracing the rise and progress of governmental institutions, religion, manners and customs, arts and sciences, from the earliest periods of the history of man upon the earth, in the light of modern scientific research. The fruits of the labors of Tylor, Lubbock, Max Muller, and other great scholars are presented in a form so attractive as to command the attention even of the most listless reader.

BOOKS TO BE NOTICED.

Legends, Lyrics, and Sonnets, by Frances L. Mace. Cupples, Upham & Co., Boston, Mass., pp. 227. $1.25.

History of the Republican Party, by Frank A. Flower, Springfield, Ill. Union Publishing Co., pp. 623.

The Home Physician, by Luther M. Gilbert, M. D. G. P. Putnam's Sons, pp. 131. $1.00.

Forestry of Northern Russia, by J. C. Brown, LL.D., Edinburgh, pp. 279.

Handbook of the St. Nicholas Agassiz Association, by Harlan Ballard, Lenox, Mass.; pp. 116.

Walls that Talk—Libby Prison, Richmond, Va. Published by the R. E. Lee Camp. 25 cents.

Catarrh, Sore Throat and Hoarseness, by J. M. W. Kitchen, M. D. G. P. Putnam's Sons, New York.; pp. 80. $1.00.

Forestry of Norway, by J. C. Brown, LL.D., Edinburgh, pp. 227.

Physician's Handbook of Pharmacy and Therapeutics, by James Lilly, Indianapolis, Ind. 50 cents.

Training Schools for Nurses, by W. G. Thompson, M. D. G. P. Putnam's Sons, pp. 57. 60 cents.

Protection to Young Industries, by F. W. Taussig, Ph.D. G. P. Putnam's Sons, pp. 72. 75 cents.

Smithsonian Report, 1882, Washington. Government Printing House.

Seven Decades of the Union, by H. A. Wise, J. W. Randolph and English, Richmond, Va., pp. 320. Cloth, $2.00.

Publications of Washburn Observatory of the University of Wisconsin, Vol. 2, Madison, Wis., pp. 400.

Department of Agriculture, Third Report of U. S. Entomological Commission, Washington, D. C.

Wisconsin Historical Collection, Vol. 9, Madison, Wis.; C. C. Washburn, President.

Smithsonian Report, 1881, Washington, D. C.; Spencer F. Baird, Secretary.

Report of U. S. Fish Commission for 1881, Part 9.

Signal Service Notes, No. 9, Weather Proverbs, by H. H. C. Dunwoody, Washington, D. C.

OTHER PUBLICATIONS RECEIVED.

Miscellaneous Papers on Anthropology, from Smithsonian Report of 1882, Washington; Government Printing House. Johns Hopkins University Studies, Herbert B. Adams, Editor; Second Series; Town and County Government in English Colonies of North America; The Toppan Prize Essay, by Edward Channing, Ph.D., Baltimore, Md. Bulletin of Washburn Labratory of Natural History, by F. W. Cragin, Vol. 1, No. 1. price 15 cents, Topeka, Kansas. Signal Service Notes, 16, Effects of Wind-Currents on Rainfall, by G. E. Curtis, Signal Office, Washington, D. C. Protection and Free Trade To-Day, at Home and Abroad, in Field and Workshop, by Robert P. Porter, price 10 cents, Boston; James R. Osgood & Co. Twelfth Cincinnati Industrial Exposition. Edwin Stevens, President. Railroads in Tennessee, Their War on the People, by John H. Savage. Circulars of Bureau of Education, No. 5, 1884, Washington, D. C. Catalogue of Books Published by Houghton, Miffln & Co., Boston and New York, 1884. Literary Bulletin of Houghton, Mifflin & Co., September. Report of Kansas State Board of Agriculture for month ending August 31, 1884. Wm. Sims, Secretary, Topeka, Kansas. Seven Hundred Album Verses, compiled by J, S. Ogilvee, price 15 cents, J. S. Ogilvee & Co., publishers, New York. Johns Hopkins University Studies, Herbert Adams, Editor; second series 8–9; Indian Money as a Factor in New England Civilization, by Wm. B. Weeden, A. M., Baltimore, Md.

SCIENTIFIC MISCELLANY.

THE ELECTRICAL EXHIBITION.

The International Exhibition now in progress at Philadelphia, under the auspices of the Franklin Institute of Pennsylvania, is the fourth of its kind, the three preceding having been those of Paris, Munich, and Berlin. All four have been held within as many consecutive years, and the reflection may occur that they are succeeding each other with too great rapidity. Yet when we observe the remarkable progress made almost from day to day in the utilization of electrical force, it becomes obvious that even the developments of a single twelve months may deserve to be gathered up and displayed in a new exposition. One of the most striking thoughts occurring to the visitor in Philadelphia is that whereas ten years ago the magnetic telegraph, that wonder of our age, would necessarily have been the central and all-absorbing feature of an electrical fair, now it is relegated to a modest corner, not for purposes of display, but to fulfill the same matter-of-fact functions that it might in a political convention or a dog show. It is the uses of electricity as a light, a motor, and a conductor of sound that now claim the chief place of honor and of interest.

The Exhibition was opened on the 3d of September—to continue until the 11th of October—with appropriate ceremonies, in the presence of a vast throng, which included many guests distinguished in diplomacy or in science. It is held in a new and spacious building, constructed for the purpose, at the corner of Lancaster Avenue and Thirty-second Street, close by the old Pennsylvania Railroad station. This latter is connected with it as an annex, and furnishes not only a fine concert hall and lecture room, but also additional area for electric railway switch and signal exhibits, and others that require much space. The spot is not far from the one on which Franklin, one hundred and thirty-two years ago, drew the electric fire from the sky along his kite string.

Despite many evidences of incompleteness at the outset, this exhibition will be a worthy successor to the finest that has gone before it. All the dynamos and electric light and telephone systems familiar to the American public—the Edison, the Thompson-Houston, the United States, the Brush, the Bell, the Bernstein, the Excelsior, the Acme, the McTighe, the Weston, and so on—are there in their familiar manifestations. Here may be seen Edison's gigantic machine, the largest dynamo in the world, the thirty ton "Jumbo," seven feet in height, nine in width, and fifteen in length, challenging the old-time supremacy of steam, as represented in the great Porter & Allen engine that furnishes power for a myriad of minor machines and wheels through the building. A dozen or more powerful dynamos and many steam-engines are met from point to point. Here are the Thompson-Houston devices for conveniently combining the arc and incandescent

system. Here is the joint exhibit of the Ordnance Corps and Signal Service of the army, with its electric self-recording rain gauge, its model of a field telegraph train and portable field telegraph apparatus, its instruments for measuring the force and direction of the wind and the velocity of projectilies, and for determining barometric pressure, besides the familiar system of signaling.

Hard by is the Navy Department's exhibit, which includes torpedoes fired by electricity and others exploded by contact; electrical appliances for firing guns separately or in broadside; a pair of revolving naval search lights operated by Gramme dynamos; electrical appliances for determining water currents or electric currents; devices for exploding torpedoes in boats, and the ingenious McEvoy apparatus for controlling a group of torpedoes from a common centre, and above all, for ascertaining the presence of hostile torpedoes by a telephonic detector sunk under the water, and communicating the news of their proximity to the patrolling boat by a peculiar low sound. In one of the towers is a great electric naval search light, perhaps the most powerful in the country, throwing its ray, by means of lenses and reflectors, over the city for a distance of more than two miles.

Fire alarms and burglar alarms of many kinds—matting with electric wires that can be put under carpets; wires and bells that connect with doors, windows, and safes; telephones in their now familiar guise, one of them communicating even with Boston; photometers and telemeters; locomotive head-lights; arcand incandescent lamps of all varieties; electric clocks and electric apparatus for minutely subdividing time—these are encountered on every hand. The applications of electricity to medicine, dentistry, and surgery find a place, as does educational apparatus for the school room. There are the marvels also of the phonograph, the microphone, and various devices used thus far mainly for entertainment. The telegraph, too, has its share of attention after all in the exhibition of its multiplex system, which allows scores of messages to be sent simultaneously over the same wire without the slightest interference or betrayal of each other—a most useful invention in these days when the multitude of wires required under the old system would be appalling.

Electro-plating, lightning-rods with their copper wires and platinum tips, the application of electricity to mining and blasting, and other familiar matters are not neglected here. Groups of sewing-machines are at work on leather or on cloth by the aid of electricity, and some of those who sew are merely doing on exhibition what they have done in their own workshops for months. There is a great case full of eggs, from which chickens are to be hatched by electricity. Storage batteries of various sorts and exhibits of electrical supplies are found, and many small dynamos seem adapted to almost any form of light sedentary labor performed by man. A great variety of globes and chandeliers is shown, and upholsterers and other tradesmen have taken advantage of this fact, it must be confessed, to make displays of very beautiful wares, which no one would like to miss seeing, though thier connection with the purpose of the exhibition seems to be merely that of demonstrating that goods of their quality light up admirably

under the electric light. In a few other instances the connection of exhibits with the central purpose of the fair may be even more obscure; still the display of gas-lighting apparatus can at least be regarded as a useful foil to electric illumination, while that of gas engines may be designed to shown that gas has yet new missions in prospect.

The literature of electricity is represented by a large collection of books, which will pass into the possession of the Franklin Institute at the close of the fair. Great maps hung on the walls of the lecture-room show the lines of sea cable, present and prospective. The history of electrical appliances is set forth by exhibits of old-fashioned voltaic piles, an electric machine constructed by Franklin, the famous instrument of Morse, and so on; and certainly one of the most striking portions of the whole display is the contribution by the United States Patent-office of the original models on which patents were granted to the most famous of existing American electric devices.

For spectacular effect, night, when all the multitudinous flames of this palace of light, both within and without the building, are flashing, is the time most favorable. Within, disposed at all available points, hanging from girders and arranged in rows along the thirteen arched rafters of the main building, are no fewer than 5,600 incandescent lights and 350 arc lights. Of the former, 1,200 are contributed by the United States Company and 3,800 by the Edison, other companies furnishing the remainder. The dazzling noonday splendor of this illumination is enhanced by a large fountain in the centre, which throws an upward jet from a mass of stone, against which shoot other great jets from the rim of the basin. The spray, illuminated by the surrounding lights, transmitted through glasses of different colors, reflects prismatic hues at every point, and falls in a perpetual shower of jewels. Beds of flowers around the basin add to the effect, as do the other decorations of the hall. While the eye is thus gratified, the electric organ attracts the ear from its position in the gallery, the key-board with which the performer plays it being on the main floor, a hundred feet below.

From an exhibition so largely devoted to practical mechanism, occupying 200,000 square feet of space, and actuated by steam-engines aggregating 1,800 horse-power, not only pleasure but scientific profit should be expected. There are about 250 separate exhibitors, and from six to eight times that number of exhibits. These cover a very wide range of electrical application, and the committees who are to examine and report upon them are mostly well-known experts, who will doubtless put them to a thorough test.—*Harper's Weekly*.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

MANUFACTURE OF SEPARABLE LAP-LINKS.—This invention relates to improvements in that article of utility commonly known as a lap-link, and to the manner of attaching it to the single-tree of a vehicle.

It consists of two circular or eliptical rings of metal, each so stamped or cut from a sheet of iron as to leave an opening through which a trace-hook or similar instrument may be passed; the pair being united at a suitable point of their circumference, by means of a strong rivet or bolt.

The said lap-link is preferably constructed by first stamping or cutting the thin, flat links directly from a sheet of metal and afterwards forming, at corresponding points in their circumference, the apertures for the reception of the rivets.

When it is desired to use a link in connection with a single-tree, a pair of the links are inserted between clamping-lugs upon the outside of a revolving ferrule where they are securely held in place by means of a heavy bolt or rivet.

The said revolving ferrule is attached to the end of the single-tree through the medium of a flanged ferrule and a screw-bolt. Such an arrangement permits the outside ferrule to revolve freely, hence the single-tree may be quickly and easily reversed.

The link and its connections may be constructed of malleable iron and it is preferable to make the outside and inside ferrules in that manner, but the link should be formed as before described.

When the two thin links are united by a small rivet, they may be used in connection with a common clevis, for coupling together the different parts of vehicle pulling-gear, and for many other useful purposes, such as forming a complete chain. The inventor is Mr. J. H. C. Wilkening, of Higginsville, Mo.

COMBINED BELT-GUIDE AND REEL.—The object of this invention is to provide a simple and efficient guiding device for the driving-belts of threshing-machines and similar apparatus, in such a manner that very little wear will be produced upon the edges of the belt, even when the same is being operated against a heavy side wind.

The device consists of a suitably sized hub that is journaled horizontally to the frame work of a machine, preferably by means of a tri-armed hanger or bracket, and carrying upon its outer extremities, or cast integral therewith, a pair of vertical guiding-discs between which the belt is adapted to run and be guided in its course toward the pulley of the machine.

The invention consists further in providing the said belt-guiding device with an aperture in each disc thereof for inserting a pin above the belt, so that when the belt is not in use and the device is revolved, by means of a removable handle, the belt may be wound thereon. as hereinafter more fully set forth.

Heretofore the edges of a belt have been rapidly worn away by reason of improperly constructed guiding pulleys, for the reason that the surface presented to the edge of the belt was quite angular and abrupt.

In this apparatus the guiding-pulley or reel is preferably constructed of cast-iron, in two similar sections or discs, the hub being cast integral therewith, and fitted to a journal projecting from a tri-armed hanger or bracket which is bolted to the machine framing. A removable handle is adapted to be inserted in an

aperture provided for that purpose near the periphery of the outer disc so that by inserting a pin through corresponding apertures in each disc and above the lower line of the belt, the same may be coiled by hand upon the hub of the device and thereby be protected from the weather, and at the same time be easy of access when occasion requires.

The driving-pulley of the machine is placed somewhat above the plane of the guiding-pulley so that both lines of the belt will be situated above the guiding-pulley journal. But it is not necessary, however, that both lines of belt should run within the diameter of the discs; on the contrary it is preferable that the upper line operate entirely above the guiding-pulley. This invention was recently patented by Mr. F. B. Ray, of Kansas City, Mo.

EDITORIAL NOTES.

THROUGH the courtesy of Mr. J. S. Chase of this city, now visiting in Dakota Territory, we have received a photographic representation of a tornado-cloud taken by Mr. F. N. Robinson, of Howard, Miner Co., D. T., August 28, 1884. The storm passed twenty-two miles west of that place at 4 P. M., moving in a southeasterly direction and remaining in sight more than two hours. It was very destructive, killing several people and destroying all property lying in its track. As a work of art this photograph is admirable, since the details of shape of the funnel and the light and dark shades of the cloud are as distinctly brought out as though the object had been a fixed one in the operator's room; while as an object of interest and information to the meteorologist nothing so satisfactory has ever come within our notice. We consider that Mr. Robinson is entitled to the thanks of all scientific men for his enterprise in this matter.

THE Fish Commission of Missouri has just published a small book of sixty-four pages, on Carp Culture, with an appendix of Native fish. It will be sent to residents of Missouri, free of charge, on application and enclosure of three cents in postage stamps. Apply to Phil. Kopplin, Jr., Forest Park, St. Louis.

PROF. A. S. GATSCHET, the noted anthropologist of the Smithsonian Institution passed through this city on the 21st of August on his way to New Mexico and Colorado. It is a matter of real regret that we were out of town when he called at the office of the REVIEW.

BY invitation of the authorities of the Johns Hopkins University, Sir Wm. Thomson, D. C. L., F. R. S., L. & E., etc., Professor of Physics in the University of Glasgow, will deliver in this month a course of eighteen lectures on "Molecular Dynamics," before the Physical section of the Johns Hopkins University. The opening lecture will be given on Wednesday, October 1st, at 5:00 P. M. The other lectures will follow on consecutive days at the same hour. Professors and students of physics are invited to attend, and arrangements will be made by which they may easily obtain temporary lodgings, provided an early intimation is received of their intention to come.

ITEMS FROM PERIODICALS.

THE *North American Review* for October is notable as well for the importance of the topics treated, as for the eminence of its writers. The leading article, "Moral Char-

acter in Politics", is by President J. H. Seelye, whose exposition of ethical principles involved in the popular election of candidates to high station in the Government must command the attention of every right-minded citizen. "Benefits of the Tariff System", a sequel to the article in the September number on the "Evils of the Tariff System", is a symposium consisting of three articles, written respectively by John Roach, Prof. R. E. Thompson, and Nelson Dingley, Jr., who advocate the policy of protection of American industries with great clearness and ability and abundant citations of statistical facts. In addition to these most timely discussions of high political issues, the *Review* has an article by the Rev. Dr. Augustus Jessop, entitled "Why I Wish to Visit America"; "The Philosophy of Conversion" by O. B. Frothingham; "The Origin of Yellow Fever", by Dr. C. Creighton; "Shall the Jury System be Abolished?" by Judge Robert Y. Hayne; "The Genesis of Tennyson's Maud", by Richard Herne Shepherd; and "The Development of Machine Guns", by Lieut. C. Sleeman.

THE October *Harper's Monthly* contains as a frontispiece a charming picture by Mr. Abby of "Judith Shakespeare," the hereine of William Black's story, which nears its close, and has more of the delightful engravings from the pencil of Dielman and Gibson, illustrating E. P. Roe's "Nature's Serial Story," part eleven. Both Mr. Boughton and Mr. Abbey illustrate the instalment of the former's clever "Artist Strolls in Holland," which appears in the number. Horace E. Scudder takes the reader to Copenhagen, "The Home of Hans Christian Andersen," and Rufus F. Zogbaum to "The Home of Tommy Atkins," who is quite an other kind of person. Tommy Atkins is the popular name for the British soldier, and the home described is the great camp at Aldershot. Both of these papers are fully illustrated by the writer himself. A Mexican metropolis, Monterey, is described and illustrated in an article called "The Gateway to the Sierra Madre," by Frank R. Brown. Two historical papers, one on King's College (now Columbia), New York, by John MacMullen, and the second by Treadwell Walden, on Westminster Hall; and two biographical—one a reminiscence of Mr. Darwin, with a portrait of him in middle age, the other the remarkable story of a slave horse-jockery, Charles Stewart told by himself and edited by a Southern lady, are features of the number. One of miscellaneous papers, on "Municipal Finance," by W. M. Ivens, private secretary to Mayor Grace, of New York, will attract much attention, and there is the usual variety of stories, poems, and departments.

THE *Science Observer* of September 14th announces that a cable message was received on the 13th, at Harvard College Observatory, from Dr. Krueger, Kiel, announcing the discovery of a planet by Dr. Luther. The position given, September 12.379, Greenwich M. T., is the following: R. A. 0h. 12m. 4s. Decl. $+ 10° 37'$. Eleventh magnitude.

THE *Art Interchange* of September 11th contains a charming design in color of a vase decorated with pink morning-glories. The addition of bronze to this design makes it most exquisite for decoration in mineral colors. The same issue also contains a beautiful picture of a girl in frilled cap, which suggests the Cherry Ripe of Millais. Price per copy, 15 cents. Pubished by William Whitlock, 140 Nassau Street.

THE *Popular Science Monthly* for October is the closing number of the 25th volume and is in full accordance with the ideal purpose of its origination. The object of the magazine has been to bring forward distinctively and prominently the higher human aspects of human inquiry, and every one of the fifteen articles of the present number sustains this character. The first paper, by Dr. F. J. Shepherd, on "The Significance of Human Anomalies," is an illustrated and very timely exposition of those aberrations of structure in the human sys-

tem, which for centuries were the puzzle of anatomists, but which are now claimed to be cleared up by the doctrine of descent and evolution. Francis Galton's paper on the "Measurement of Character" is a skillful and most suggestive attempt to bring the higher human characteristics within the pale of quantitative science. Lord Rayleigh's survey of "The Recent Progress of Physical Science," which was his presidential address before the Montreal meeting of the British Association, is given in full, as it deserves to be, though elsewhere it appears only in abstacts. A biographical sketch and fine portrait of Lord Rayleigh are also given. "Diet for the Gouty," in Professor William's series on "The Chemistry of Coockery," "Wages, Capital, and Rich Men," "Physiological Aspect of Mesmerism," "The Morality of Happiness" (conclusion), "Protection against Lightning," "The Cholera-Germ," and "The Origin of Cultivated plants," are all fresh, readable, and valuable papers. Professor J. P. Cooke contributes "Further remarks on the Greek Question," and the editor keeps up his fight with the classicists for more room and higher consideration for science in education.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from* 15 *to* 20 *per cent off the retail price.*

THE October *Atlantic* contains several articles which will appeal to widely different classes of readers, Dr. Weir Mitchell continues his excellent story, "In War Time;" Francis Parkman, the distinguished historian of Colonial America, writes of the "Battle of Lake George;" Elizabeth Robins Pennell discusses the "Relation of Fairies to Religion;" Louise Imogen Guiney praises Leigh Hunt, whom she styles "An English Literary Cousin;" Bradford Torrey, who has recently contributed several admirable articles about birds, this time describes various "Minor Songster;" George Houghton has an article entitled "Washington and his Companions viewed Face to Face;" J. Howard Corbyn furnishes the short story of the number, "Buckshot: A Record." The classical article of the number is by William Shields Liscomb, on "The Migrations of the Gods;" Margaret Bertha Wright gives an account of a French "Bourgeois Family;" Charles Foster Smith writes of "Southern Colleges and Schools;" Edith M. Thomas contributes a charming short article on "The Solitary Bee;" and an anonymous writer, but evidently one who wields a practical pen, writes a second article on "The Lakes of Upper Italy." There are poems by Oliver Wendell Holmes, Cecil Thaxter, and Augustus M. Lord. A review of several important new books and the usual collection of bright short essays in the Conbributors' Club, with an account of the Books of the Month, complete another substantial number of this sterling monthly. Houghton, Mifflin & Co., Publishers, Boston.

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

KANSAS CITY

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GEOGRAPHY.

THE TERRITORY OF WASHINGTON.

R. J. MC CARTY.

The Cascade Mountains running nearly parallel to the Pacific Coast and about 100 miles from it, divide the Territory into two parts. The eastern moiety, known as "Eastern Washington," is, generally speaking, a high, rolling prairie, through which winds the great Columbia and Snake Rivers, and which, from their tortuous courses and their many branches of running water, make it an exceedingly well watered region, excellently adapted to pastoral purposes. The soil is formed from the decomposition of volcanic deposits *in situ*, and is deep, rich, and easily pulverized. The smaller cereals can be produced in great abundance, but corn will not thrive, owing to the dry summer and cool nights; however, since this valuable cereal has often shown a willingness to adapt itself to uncongenial conditions elsewhere, it may yet become sufficiently acclimated by experiment. An effort is now being made in this direction, which, if successful, will greatly enhance the agricultural importance of the Territory.

The one thing which the Territory of Washington needs is a railroad line from Puget Sound across the Cascade Range in the direction of Walla Walla,—and, though the people have all along realized this, though they have planned, struggled, and almost wept for it, they have so far been defeated by the policy of the Northern Pacific Railroad Co.

Congress, by Act of July 2, 1864, and subsequent acts amendatory, author-

ized the Northern Pacific Railroad Company to construct a railroad from Lake Superior to Puget Sound, with a branch, *via* the valley of the Columbia, to Portland, Oregon,—and to aid the enterprise granted to the company forty alternate sections of land to the mile. On April 10, 1869, authority was granted for extending the Columbia River branch to Puget Sound, to connect with the main line, which was then to be built across the Cascade Mountains, and it was specified that no land or other subsidy should be given for this extension of the branch line. By some means Congress was prevailed upon afterwards to declare the Columbia River line the main stem and the Cascade line the branch, so that the grant was thus made to cover both.

This was all done by Congress with the proviso that the lines should be built by July 4, 1879. Since the "Cascade Branch" has not yet been built and the Columbia River line is not finished, connection being made over the O., R. & U. Co.'s line from Wallula to Kalama, it is claimed by the people that the land grant is forfeited. Yet such is the anxiety for a railroad across the Cascades that many are against forfeiture if the company will build the line in three years—yet again many are in favor of unconditional forfeiture. The former comprise the "railroad," the latter the "anti railroad" party. This is the main issue in the present electoral campaign. The anti-railroad party is in the majority, but since old party lines are still drawn tightly, and since the republicans have nominated a railroad and the democrats an anti-railroad ticket, it is a kind of a quadrangular fight, with nobody in particular yet on top.

That portion of Washington Territory west of the Cascade Mountains is divided by local geographers into two parts. The region drained by the streams which flow directly into Puget Sound is called the "Sound Country," the remainder is known as "Western Washington." Of this last, all that portion lying west of the meridian through Victoria, B. C., and north of the parallel of latitude through Tacoma, having an area of 3,300 square miles, is an inhospitable wilderness of ragged mountains, and can therefore never be of great political or commercial importance. Still it will forever furnish unmistakable landmarks to the navigator and will always fill the poetical office of diversifying and rendering sublime the otherwise beautiful landscape.

As seen from Seattle nothing can exceed the modest sublimity of these mountains. They have not those round spiritless summits, that hog-back aspect, suggesting the idea of a huge pile of dirt, so common with other mountains of similar height; nor do they overwhelm one with their loftiness. Their summits stand out sharp and clear against the sky, like a cluster of giant pyramids, and, though the glittering crust of distant Ranier shoots far above them, they seem to gain, not suffer, by the contrast.

The remaining portion of Western Washington is much the same as to soil and topographical configuration as the "Sound Country." As has been said, the "Sound Country" lies adjacent to and comprehends that archipelago known as Puget Sound. This name, in honor of one of Vancouver's lieutenants, was originally given to that body of water adjacent to Olympia, Steilacoom, and Ta-

coma; but in time its meaning was made to comprehend all that body of water which penetrates the land in all directions from the eastern end of Fuca's Strait.

If one were required to make an ideal map of a country which would offer the greatest facilities for water transportation at the least expense of dry land, he could do no better than copy the map of Puget sound. The area of the "Sound Country" is about the same as that of the State of Massachusets, three-quarters of which is land and one-quarter water. About one-third of the land is situated on the slopes of the rivers and streams running into the Sound. In any portion of the remaining part it is difficult to find a point further than six miles from deep water.

In fact, Puget Sound may be likened unto a broad deep river returning upon itself, intersecting itself, and throwing out branches often and again. One of the peculiarities of this body of water is its great depth and another is the want of anything like a beach, the largest ships being able to run within a few feet of the shore almost everywhere with perfect safety. While this is excellent in meeting the important requirement of keeping ships afloat, it works mischief when it is desired to keep them from floating off, for the Sound is so deep in most places and quite near the shore that it is difficult to get anchorage.

Another peculiarity of this contorted stream which grows out of its peculiar shape, is the motion of the water under tidal action. The tide of course is due entirely to the momentum of the tidal wave which covers up the Strait of Fuca. By reason of the obstructions which it meets and of the distance it has to travel, the tide wave in the Sound is unable to connect with the ebb and flow at the Strait, so that at various points in the Sound it often happens that two or more tide waves meet with great violence, forming a tremendous convulsion of waters, which, while not at all dangerous to the larger craft, makes it hazardous to venture out in some localities in small boats.

From the above it will be seen that the Sound Country is, perhaps, possessed of the finest natural transportation facilities on the globe.

Howsoever great may be the natural resources of any region it avails nothing unless these resources be accessible and marketable. And since labor is the foundation of all wealth, and since man must be assured of subsistence and safety before he can work, and must be able to barter the product of his labor before he will, it is impossible to develop any country without adequate transportation facilities. It is to this principle that the railroad owes that power and importance which has enabled it to extend the bounds of civilization in the interest of enlightened society and to the confusion of the naked savage. When therefore a habitable region is found in which nature has built innumerable highways, requiring no repair and ready for equipment, it is safe to predict prosperity, even if natural wealth is limited.

The natural wealth of the "Sound Country" is both great and diverse. Though the highlands are rough and broken and not so well adapted to agriculture as are the prairies of Illinois, they are covered by a forest, an accurate account of which would appear fabulous, such is the number and size of its deni-

zens. The fact is, the occasion for testing the agricultural worth of these highlands has not yet arisen and no one yet knows whether they have any value aside from the timber which covers them. The reasons for this are the great cost of removing the monstrous stumps and the comparative ease with which the valley lands can be cleared.

These valley lands are fully as rich as any in the States, and are admirably adapted to hop-growing, which is the principal agricultural industry. Although but a small portion of these lands were under cultivation in 1880, this Territory ranked fourth among hop-growing States, having been surpassed only by New York, Wisconsin and California. The average crop of hops is about 2,000 pounds to the acre. The cost of producing and preparing for market is about eleven cents per pound, and the market price will average about twenty-one cents. This gives a net return of $200 per acre. Such lands are held at from $100 to $125 per acre, which, judging from results, is not too high.

The trees which cover the highlands are mostly fir and cedar, while the valleys nourish maple, ash, elder, willow, and a little oak, though practically there is no hard wood timber in the country.

Along the eastern shore of the Sound there are vast deposits of coal. Lignite of a good quality forms the bulk, though there is some bituminous. Whether there are any deposits which deserve the name of anthracite is yet problematical. Again, it is claimed, and it is no doubt true, that large deposits of iron ore of excellent quality can be found on the western slope of the Cascades.

The climate of the "Sound Country" is remarkably equable as to temperature, and almost entirely free from atmospheric disturbances of any kind. Thunder and lightning are strangers in the land, and howling winds unknown. Even brisk winds are rare. There is, however, usually a smooth, soft breeze stirring which enables the sailing craft on the Sound to navigate, and which adds greatly to the pleasurable climate.

About the first of April the dry season begins, which lasts until about the first of November. During this period the wind is usually from the northwest; occasionally it shifts to the south and when it does the weather becomes cool and damp, the low temperature produced by the Cascade Mountains causing the dampness.

The air is always laden with moisture and when from any cause the temperature gets below about 45° F. it becomes damp; on the contrary, any cause which keeps up the thermometer will keep the weather dry. Now, since there are no winds worth mentioning, there is no chance to vary the temperature with air from other regions, so that it may be assumed that the climate depends wholly upon the position of the Sun. About the first of November the position of the Sun changes the temperature of the air and brings it to or below the dew point, causing fog or rain for the most of the time until the first of April.

This condition of almost constant dampness is not so unpleasant as one would at first suppose; for there is hardly ever a violent precipitation, the average rain being more like a dense fog which does not readily penetrate the cloth-

ing, but remains on the surface much after the manner of snow. Besides the mist falls vertically and is easily kept off by an umbrella which a man can hold over him without freezing his hands off. It always did seem a waste of labor and fortitude for a person to struggle with freezing hands to keep an umbrella over him in a howling blast of horizontal rain. It is much more sensible to put one's hands in one's pockets and hurry home.

Happily it is not necessary to do either here. During the summer the thermometer rarely reaches 80° F. and the cool nights are highly conducive to sleep. During the winter, while water rarely freezes, the excessive moisture makes the cold much more sensible than an equal temperature elsewhere. Notwithstanding this, everybody is satisfied with the climate; so much so, indeed, that once here no one wants to leave, or having left there is no one but wants to get back. It is even true that some do not like to go away on a visit for fear they won't get back.

A slight change of position makes a great difference in climate in this region, for though the above outlines the climate of the Sound, it does not apply to that of Eastern Washington, which is, however, much more equable than that of any of the States east of the Rocky Mountains. So that with rich land, inexhaustible quantities of timber, coal, and iron, all easy of access independently of railroad construction, it does not require a prophet to see that this same "Sound Country" is destined soon to become one of the richest and most prosperous of regions, as it is now one of the most pleasant.

The white man in his westward journey around the earth seems to have here reached the jumping-off place and to have been compelled to mingle with the poor savage whom he could drive no further.

The Indians of Puget Sound belong to the nation of Flatheads, a name derived from their practice of "flattening" the heads of their young. They bind the child, on its back, firmly to a board with many thongs, one of which passes over the forehead which is protected by a pad. This pad they press from time to time and thus gradually outrage nature. The effect of this operation is to depress the forehead, make more prominent the high cheek bones, elongate the head, broaden and flatten the lower part of the face, and to effectually stamp out every lineament of beauty or intelligence. They are such thieves that some merchants will not admit them unless they have some idle clerks to watch them, preferring the loss of their profit to a total loss.

There are many different tribes of these Flathead Indians, and each tribe has a language of its own. In order to remove the obstacles to trade which this confusion of tongues engendered, the Jesuits many years ago, in the interest of the Hudson Bay Company, made up a compound of all the languages and by introducing a tincture of French, originated what is known as the "Chinook Jargon," or "Indian trade language of the North Pacific Coast," which is now spoken by all the various tribes.

This language contains 493 words, from which the letter "r" is religiously excluded, which seems to indicate that the Flathead can no more pronounce that

letter than can his Mongolian brother, whom he resembles in more respects than this, but whom he hates with all the acrimony of his benighted soul.

For the benefit of those sufficiently curious, the Lord's Prayer in Chinook is subjoined:

Nesika Papa klaksta mitlite kopa saghalie kloshe kopa nesika tumtum
Our Father who stayeth in the above good in our hearts
mika nem; kloshe mika tyee kopa kouaway tilikum; kloshe mika tumtum
(be) thy name; good thou chief among all people; good thy will
kopa illahie, kahlua kopa saghalie. Potlaeth kouaway sun nesika muckamuck.
upon earth, as in the above. Give every day our food.
Spose nesika mamoak masahchie, wake mika hyas solleks, pe spose klaksta
If we do ill, (be)not thou very angry, and if anyone
masahchie kopa nesika wake nesika solleks kopa klaska. Mahsh siah
evil towards us not we angry towards them. Send away far
kopa nesika kouaway mesahchie. Kloshe kahkwa.
from us all evil. Good so.

The canoe is to the Sound Indian what the mustang is to the wild Comanche. These canoes are dug out of cedar logs and are remarkable for grace and symmetry. The swiftness with which they can be driven through the water by a single oar, or rather paddle, is surprising and suggests the idea that the instinct of the Indian is, perhaps, as good a guide in shaping boats as the formulated experience of science.

The Sound Indian, or "Si-Wash," as he is called in local parlance, is a docile and useful member of society. He fills nearly the same place here as the negro does in the south. His principal avocation when not at work on the farms, is that of a fisherman, at which, owing to the immense quantity of raw material and his high degree of skill, he is a pre-eminent success. The waters swarm with fish,—the Sound with salmon, rock-cod, tom-cod, halibut, smelt, flounder and others, and the streams with the vigorous mountain trout. It is a disgrace to go fishing and return empty-handed. The "Si-Wash" is therefore indispensable to the honor of the unlucky sportsman.

The presence of the Chinaman here teaches that virtue much abused may be transformed to vice, and that there is iniquity in the too liberal application of the generous principles of our government. It is to be fervently hoped that statesmen will profit by the terrible mistake of ever allowing these leprous creatures to inundate our shores. The restriction act has only checked the malady, not cured it, and even now complaint is made that it does not restrict. Chinese have been known to get through by hiding in the wheel-houses of steamers, a fact which speaks well both of the reputation of our country in China and of the celestial determination to get here.

Everybody knows that the Territorial Legislature last year granted women the right to vote. It is claimed that the bill was traded, sprung upon the assembly in an unguarded moment, and passed against the sense of the majority. However that may be it became a law November 23, 1883. The law defining the qualifications of voters originally read:

"All American male citizens above the age of twenty-one years, and all American male half-breeds over that age, who have adopted the habits of the whites, and all other male inhabitants of this Territory above that age 'who shall "have declared on oath their intentions to become citizens, at least six months "previous to the day of election, and shall have taken an oath to support the "constitution of the United States and the organic act of this Territory, at least "six months previous to the day of election, and who shall have resided six "months in the Territory and thirty days in the county next preceding the day "of election, and none other, shall be entitled to hold office or vote at any elec- "tion in this Territory."

This was amended by an act approved November 23, 1883, to read as above with the word "male" stricken out, and thus was the political distinction of sex obliterated.

The law in regard to the qualifications of jurors reads thus: "All qualified "electors shall be competent to serve as petit jurors and all qualified electors and "householders shall be competent to serve as grand jurors within the county in "which they reside and within any county or district to which such county may "attached for judicial purposes."

At the spring meeting of the Board of County Commissioners the venire for grand and petit jurors are made from the tax list. It is true that nothing in the above compels the board to place women on either venire and it seems that certain influences were brought to bear to exclude them. The probable objections being that jurors are already sufficiently uncertain, that impaneling women would make them absolutely precarious; that men and women don't view things alike, and that the lawyer would be apt while convincing one part to lose his case with the other; that woman by reason of her peculiar duties and conditions was not fit to be a juror; that the association was in some cases improper, the testimony unchaste, and that she would try to enforce impracticable ideas of morality. These objections and many others too numerous to be known would probably have had their effect had not Judge Greene of this third judicial district notified the board that he would quash any venire which did not include a fair proportion of women.

Judge Greene is a most excellent gentleman, an able judge, and an ardent advocate of woman's rights. He proposes to give the experiment a fair trial, and to that end to push its application to the furthest consistent limit; and, on the principle that it is in the end best to enforce a law whether good or bad, he is perfectly right, and judging from the character of the man he would do the same thing if he happened to hold other views. Thus it happens that women must sit on juries. at least in this district. This seems to have created a change of heart on the part of some of the whilom advocates of the measure, and the opposition are even now agitating for repeal.

At best the innovation is yet an experiment. Men dread the censorious tendency of woman in matters of morality, even when it cannot be emphasized at the polls, and for this reason even some of those who were once in favor of

the measure begin to feel like one who has equipped his enemy for battle. This was made perfectly clear during the municipal campaign at Seattle, in June and July last. There is of course in every community an element which, with an iron-clad system of morality, would run down every ostensible vice, regardless of any social or commercial interest which they might overthrow in their career. Now, ordinarily, and especially in new countries this element is too feeble to be feared; but nobody could estimate the strength it would gather from the female vote. It therefore became necessary either to propitiate this rectilinear element or to prevent its reinforcement by its natural allies, the women.

It was a struggle of great activity in which the conservative element triumphed by a majority of 112 in a total vote of 2,526. The total number of registered voters was 2,845, about 700 of whom were women, and when it is remembered that in a new country like this the number of males greatly exceeds the number of females it is possible that, comparatively, both sexes were equally well represented.

Whether the result of the election was due to a splitting of the female vote by the influence of the male relative, or to an actual paucity of numbers is difficult if not impossible to determine, but it certainly did not arise from any want of interest on the part of the new voters. The strongest minded were on hand at the polls dispensing tickets and electioneering; they had carriages sent to the houses of their more diffident sisters, who shrank from the ordeal of going up before a crowd of gawking men and "sticking a piece of paper in a hole cut in the top of a box."

Enough transpired to teach the corrupt element of society that there was a Nemesis on its track of which it would be well to beware, and to show that the experiment has so far had a marked tendency to purify the political and commercial atmospheres. In this respect it is probably a success. Again, there is no doubt, (if it is conceded that punishment prevents crime) that the presence of woman in the jury box, especially in those cases where domestic felicity is invaded, will have a wholesome effect. But whether the new relations which are thus created between the sexes will not damage woman more than it benefits society is problematical.

It will not do to rush too rapidly to conclusions. What would be admirable here might be iniquitous in the extreme in other localities where the relative numbers of the sexes are different; so that even should female suffrage prove a pre-eminent success in this Territory it would prove nothing in a general sense. Taken as a whole Washington Territory is a pleasant, promising spot. There is none of the *frontier* element to menace the lives of peaceful citizens. The pioneers are, as a rule, intelligent, progressive men, and one is struck with the entire absence of that link between the savage and the civilized, the unprogressive backwoodsman; so that society is fully as cultured and refined and occupies as high a plane as elsewhere. 'Tis true the distinctions of caste are not so finely drawn as at the "Hub," but yet are drawn full fine enough. The laws are well enforced, and the foot-pad and the vagrant are incontinently "bounced" on first

appearance. In a word, there is to be found here all the freshness and room for enterprise of a new country, and all the intelligence, thrift, and social order common to the Western States.

SEATTLE, W. T., October, 1884.

COLORADO—A GLANCE AT ITS MINING AND OTHER ATTRACTIONS.

A. J. WHITE.

Ten millions have been paid annually for mining labor in Colorado for the past five years. The mining machinery employed during that time—not including the smelting and milling machinery—would not exceed six million dollars in value. The bullion product during that period has been about $22,000,000 annually or $110,000,000 in the aggregate. Ten million dollars are annually taken from the State and paid to eastern mine owners in dividends, enough in fact to pay for all the labor of mining and prospecting. But with all this splendid showing there is a possibility that Colorado and its rich mining industries are not well understood.

An army of disappointed adventurers have left the State since the Leadville excitement of 1879–80, carrying words of condemnation upon their lips. They had not succeeded, and mining was, of course, a humbug. Undoubtedly their influence has had something to do with the present quiet business in the State, yet with all this, last year the mines produced $26,376,562 and exceeded any previous year. This was a surprise to many, for the population had decreased and everything moved on quietly. It is now a well established fact that gold and silver mining does not require a large population to carry on its business. Two Lowell cotton factories employ as many operatives as there are miners employed in the Leadville mines, and yet who would think of building a city to be supported by their labor.

In the great work of transforming a rugged and almost impassable country from an unproductive condition, to be one of the greatest producers of gold and silver in the world, has required a heroism and sacrifice unknown to agricultural States. In 1870 the map of Colorado was a meaningless scrawl. Then the population was less than 40,000; now it is 302,300. Then it produced nothing, comparatively, in gold and silver; now it furnishes one-fourth of the bullion produced in the United States and Territories. It had a meager cattle interest at that time, now its grass-feeding animals are valued at over $50,000,000. Only a few scattering ranches were to be found in Colorado in 1870, now 1,500,000 acres are under ditch, and the profits from farming are proportionately greater than in almost any other State. It furnishes coal and coke for New Mexico, Arizona, Utah, portions of California and some of the Territories, and last year it produced 1,220,638 tons It produced last year 47,106 tons of iron ore, a large

portion being consumed by the Pueblo Iron Works, the ore being of a quality known as "magnetic iron ore" from which the best of Bessemer steel rails are manufactured, and a superior quality of nails is made that has practically driven all eastern nails out of market.

But the greatest expense and labor has been in determining where were the deposits of silver and gold of sufficient richness to justify working. The State has an area of 104,000 square miles, and a hundred times more difficult of approach in its natural condition than a level or rolling country.

The passion for discovery was never more intense in the breast of Cortez than has filled the hearts of Colorado prospectors since 1874. A mere handful of men, exceeding at no time, perhaps, over 15,000 active workers, they have hewn through flinty granite and porphyry the royal roadways to wealth, that now intersect with a splendid system nearly every mountain and gorge of this enchanting domain. Throughout the whole State towns and cities are built provided with all the demands for comfort. The area for profitable mining has commenced since the labor and sacrifice of preparation is over. Years ago the area of mining in Colorado was measured by the league or square mile—now the eye can trace its boundaries at any given point.

The really valuable mining ground in any country is much less than is generally supposed. At Leadville, if it were collected together along the entire carbonate belt extending for fifty miles or more, it would not exceed five miles square. The mines at Red Cliff, thirty miles north of Leadville, which have produced for the last three years 100 tons per day of marketable ore, are found upon Battle Mountain within a radius of a half or three-quarters of a mile. That whole country bordering and west of the Arkansas Valley, reaching over as far as the Gunnison country, shows silver and gold, and may been mentioned as a mining country, yet profitable mining can only be prosecuted in small patches of ground and only a few mines contribute to give the several districts a character and name abroad. Yet the possibilities of these patches of rich mineral deposits are beyond all calculation. In the great San Juan those localities which first attracted attentiòn and led to the rapid settlement of the country, are little farther advanced than they were in 1875, yet small areas of very rich ores are now determined and new and valuable points are ascertained, and San Juan now presents a larger and better known field for profitable mining than can be found in any State or Territory outside of Colorado.

The only profitable mines in the Red Mountain district, which is really a new Leadville in richness, are found within an area of one mile square. Crossing the range to the north of Red Mountain you find Marshall Basin, which has the largest area of rich, paying ores in the State, it being about three miles from the head of the basin to the San Miguel Valley, and paying mines are found with almost unbroken regularity upon the northern slope of the basin and a few in the center and upon the sounthern slope. Between Marshall Basin and Ouray—a distance of sixteen miles—the real rich ores that can be developed profitably are found in small scattered areas.

The waste of labor and money required for this determination has been great, but necessary. Nothing but a mad enthusiasm could ever have accomplished it. For this reason mining excitements, while they turn back an army of disappointed men into the plow-field, store, and workshop, from whence they came, to recount their hardships and losses to their friends, are a permanent advantage and should be encouraged. Colorado at the present time has about 2,000 miles of railroad and has expended millions in building wagon-roads and tramways to accommodate its business. With a climate that is a balm for all of life's sorrows, and a people generous and enjoying that true nobility of manhood which only a resolute experience can develop, the centennial State stands the peer of all others in its attractions.

HISTORY.

BLACK-BIRD—INDIAN CHRONOLOGY UNTRUSTWORTHY.

ANSWER TO MR. FULTON, BY OSCAR W. COLLETT.

In the September number of the REVIEW, Mr. A. R. Fulton, of Des Moines, Iowa, undertakes to correct a chronological statement, or inference rather, of Mr. Collett's, as to the year of Black-Bird, the Maha chief's, death, "from the record left by so reliable an authority as Lewis and Clarke;" but instead of letting his "reliable authority" speak for himself, Mr. Fulton puts in a gloss of his own, which the text does not warrant. Lewis and Clarke had no previous knowledge of Black-Bird, or his nation, and their information on the subject was derived in the following manner: On arriving at the Omaha village they propounded questions in English, which some one put into French for the interpreter, Bolon or Dorion, who in turn rendered them into the tongue of the natives; their answers were made into French, the French into English, and this is what was noted down. Thus the "so reliable an authority," about which the point is made, means just this and no more, that Lewis and Clarke honestly report the information, *as they understood it*, obtained in the round-about manner described. The testimony is not their testimony, but the statements of Indians.

One of the purposes of Mr. Collet's paper was to cite a recent illustration of a well known fact; namely, that Indian computation of time—years, months even—cannot be trusted; and this of itself should have put Mr. Fulton on his guard to read his authority carefully and distinguish between facts reported on personal knowledge, and chronological statements derived from the aborigines. Had he done so, he would scarcely have felt so strongly as to say: "The account which Lewis and Clarke obtained in regard to the great chief Black-Bird, is certainly quite conclusive as to the time and manner of his death and burial."

It may be remarked incidentally, if Mr. Fulton has published all there is in the journal (a copy of which is not at hand) on the subject, that there is not a word as to the "*manner* of the chief's death or burial."

Mr. Collet knew that Lewis and Clarke mentioned certain details relating to Black-Bird, but rejected the chronological determination of a fact on Indian testimony as by them reported, when there appeared to be other evidence strongly contradicting the Maha date. Augustus Chouteau came to St. Louis with its founder, Laclède, in 1764, and was personally cognizant of every fact relating to the city he mentions in his depositions. His statements are the accepted data of much of St. Louis' early history. He testifies (Hunt's Min., Vol. 1, p. 107,) that on May 15, 1801, the small-pox first made its appearance in St. Louis. There are other depositions to the same effect. In St. Louis local annals the year 1801 is universally known as *année de la picotte*—small-pox year; and, as succeeding *année du grand hiver*—the year of the great winter (1799—1800), when according to Chouteau, who also deposes to the same facts, the thermometer marked a lower temperature than ever before known. Such concordant testimony fixing the year of the small-pox cannot be set aside, and must over-ride Indian chronology if antagonistic. It has always been an accepted fact that the small-pox was brought to St. Louis by boats coming up the river, and thence spread among the Indians. The month and date given by Chouteau was the usual time of the arrival of the merchants' supplies. The traders left for the Missouri in the fall of the year, the large boats on the opening of navigation, at the beginning of March if possible. The first departure, after the appearance of the disease in the village, would arrive at the Maha country in the last months of the year 1801; the next, in May, 1802. If by those the small-pox was communicated to the Indians of the Maha locality, it may have become epidemic during the winter of 1801-2, but if by these, not until the summer of 1802. As the Omaha chief is believed to have died after the malady had become epidemic, we can scarcely escape the probable conclusion that his death occurred in 1802, but in no event earlier than the close of 1801.

This presentation of facts and probable inferences is in direct conflict with Indian chronology on the point in question. By all who know how little trust is to be placed in the dates assigned to events by the Indians, it is believed that it will be accepted without the least hesitation in preference to their statements.

ST. LOUIS, MO., September, 1884.

BLACK-BIRD.

G. C. BROADHEAD.

The articles in your Monthly, for August and September, are interesting as they relate to a noted chief of the a once powerful but now extinct tribe of Indians. Extinct as a known tribe but a few of their descendants have been incorporated in other tribes.

The Mahas, or Omahas, according to Irving pronounced Omah-haw, were numerous before the small-pox nearly annihilated them. They have been mentioned by Lewis and Clark, Irving (in Astoria), and Major Long in his Expedition to the Rocky Mountains.

Lewis and Clark (1804) say that Black-Bird had died about four years before.

Irving (in Astoria) relates that Wilson P. Hunt passed the mouth of Platte River April 28, 1811. A few days after he passed the place of the burial of Black-Bird (Wash-ing-guh-sah-ba), and says he had died about ten years before.

Lewis and Clark gave the date of the death of Black-Bird about 1800. Washington Irving about 1802, and Major Stephen Long at 1800. Washington Irving says that Black-Bird was one of the first among the Indian chiefs to deal with the whites, and that he showed great sagacity in levying his royal dues. In this way he became rich and also exceeding popular among the traders of the Missouri. But his people finally became dissatisfied. But a trader instructed Black-Bird in the virtues of arsenic, and told him that through its use he could obtain unbounded sway over his people. After that he ruled them by terror, and any one disputing his authority, his downfall was prophesied and death would finally ensue.

But in Little Bow a rival of Black-Bird arose, who opposed his power. Black-Bird determined to destroy him, and for this purpose his wife was bribed. But she could not effectually conceal the perfidy and confessed her guilt "that Black-Bird had given her some of his terrible medicine to mingle with his food." She thus fell a victim. Little Bow seceded with nearly 200 followers and established a separate village. [1]

But Black-Bird was a warrior of the first water and his exploits were the theme of young and old. Under his rule the Omahas obtained great power. He waged a fierce war against the Ottoes, until the whites finally mediated and peace was restored. He also warred against the Pawnees and burned their village. He was fearless in battle and generally victorious.

At one time a war party of the Poncas had made a foray on the Omahas and carried off a number of women and horses. He took the field with all his braves and swore that he would eat up the Poncas. He defeated them and they took refuge behind some mounds of earth. The Poncas sent out a herald with a calumet of peace. He was shot down, and so was each one that was sent out. At last the Ponca chief sent out his beatiful daughter arrayed in her best attire. Her charms touched the stony heart of Black-Bird. He accepted the pipe at her hand and smoked it, and from that time peace reigned between the Poncas and the Omahas. The beautiful damsel became Black-Bird's wife and she exerted great power over him. But he was fierce and vindictive, and during one of his passionate fits his wife had the misfortune to offend him, when suddenly drawing a knife he laid her dead at his feet. His passion was at once gone. Drawing his buffalo robe over his head he sat down beside the corpse and remained there without food and apparently sleepless for three days.

1 Long's Exp., Rocky Mountains, 1819.

His people could devise no means to attract him. At length a woman brought a little child and laying it down placed Black-Bird's foot upon its neck. The heart of the savage was touched. He threw off his robe, made a harangue upon what he had done and from that time on seemed to have thrown off the load of grief and remorse. He died of the small-pox.[2]

When he found his end approaching he called his warriors around him. He told them that his desire was to be buried on the top of a high hill overlooking the river from whence he had been accustomed to view the approach of the white man. He also directed that he should be interred seated on his favorite war horse. His orders were carried out and from the top of the mound was erected a staff on which floated his banner and the scalps he had taken in war.

ARCHÆOLOGY.

DID THE ROMANS COLONIZE AMERICA ?—Conclusion.

M. V. MOORE.

II. The Latin Term.—We shall consider next the term for Water or River, used by the Romans.

It must be admitted that the Roman geographers were familiar with antecedent literature—with antecedent river nomenclature especially. But notwithstanding the fact that the Latin was a composite language, there are many words therein, the existence of which were unknown until the Roman language had its birth and became fixed in the literature of the world. Among these words was the well-known term Aqua, with its peculiar Latin pronunciation. Although a cognate of the Sanscrit and the Celtic terms, the equivalent of our word for water or river, its birth is at a well-defined historical period.

And yet if we accept the testimonies of the early explorers of America, this word Aqua was well and thoroughly known, and correctly spoken, by the native peoples here wherever the foot of the pioneer trod.

The very first river names recorded by Columbus and the secretaries of his expeditions reveal the word Aqua. The revelations come to us tinged with the Spanish of the writers, and very naturally so too, in the garb of "agua"—this being the Spanish writing of the Latin term. But the examples are recorded as "native words." Among others are Xagua, Xaragua, Cubagua, and Yagua or Yagui.[1]

The initial X in these examples is but the Spanish representation of our English Ch: an English transcript of the same syllabic sounds would give the word Xaragua as Charaqua.

2 Irving—Astoria.

1 See Irving's "Columbus," Vol. I, p. 154.

Columbus records many of the aboriginal river or water names wherein the Celtic term Acha is apparent, in the writing "aca"—as Jamaica, Macaca. etc. The words Carib and Cariba—and about which the discoverer evinced so much concern—are also easily located in the Latin language which contains *Caribus* (from the Greek); this being the Roman word for sea-crabs or turtles. The world knows how famous the West India Islands have long been for immense crustaceans, the celebrated green turtles. In the word we see the origin of "Carabean"—"Caribbean Sea."

There is a long list of aboriginal river names (and other words having analogous origin) showing the term Aqua in purity. There are countless others rendered with so slight an infringement upon the correct orthography of the word, we can readily understand that the corruption is due, not to the aboriginal pronunciation, but to the versions of modern scribes; as for instance, "acqua," "aquo," "aqui," "aque," and "agua," instead of merely Aqua, in such names as Acquasca, Aquokee, Aguachapa, etc., etc.

Again: we often labor under difficulty in determining what is an aboriginal name or a mere Spanish one in those sections of the New World that were long under Spanish domination. There is one fact, however, that assists in removing doubts. The modern Spanish ideas in the application of river names in America, were not always based upon the aboriginal models heretofore referred to. The priesthood accompanying the expeditions of early colonization had much to do in the coinage of nomenclatures here. Hence, names not purely Indian are often found with a prefix indicative of the Spain of three hundred years ago. We have numerous *Saints* in the "Sans," and other titles pertaining to ecclesiasticism,[2] in the Spanish names in America. "Rio," also, often appears in connection therewith; while words that evince a conformity to the Indian models may be safely written as "native names," even though they do at times indicate tho Spanish idioms. Among these are Aguapahee, Aguila, Ahagua, Aguadeela—and many others. (Pronunciations given in these words are not always the foreign writings thereof.) The "ahee" of these names reminds us of the Germanic Aha, and La is evidently Li or Ri.

In addition to names already written showing the presence of Aqua in the Indian nomenclature, we may cite the following:

Acquia (of Va); Aquiras (Brazil); Agaqua (Tenn.); Talaquah (in various places in the South); Chatauqua and Chapaqua (N. Y.); Cofaqua (Mexico); Aquehono (Texas); Alaqua (Florida); Atchalaqua (Ga.); Tamaqua (Pa.); Telaqua (Tenn.); Aquakannock (N. J.); Aquala (Ga.); Aquona (N. C.); Piscataqua (N. H.); Maaqua (N. Y.); Inctaqua (N. C.); Sadaquada (N. Y.). The list might be extended.

Aquana is the same as Abana. Both names are found in the Indian. The Sadaquada was written also by the French Sauquoit. It is one of the tributaries of the Hudson or Maaqua (through the Mohawk).

In words like the following it is difficult to determine to which root the Indian

2 Florida was discovered on Palm or Easter Sunday, a day celebrated by the Church—hence the name.

name belongs—whether to the Latin Aqua, with its Spanish rendering, or to the Sanscrit Ogha (which is perhaps the true parent of the later word). The evidences, however, are in favor of the Latin, from the fact that in the Old World, among all the titles given to the rivers, *this version or pronunciation of the Sanscrit word is rarely if ever found*:—

Nicaragua, Autaugua, Watauga, Saguana, Chickamauga, Connesagua, Paragua (Paraguay), and Uragua. We have also such names as Chicago (*Chuckagua*, one of the early names of the Mississippi), Canadinagua, and many other "aguas." What is supposed to be one of the earliest writings of the name now written Connesagua is in *Canasaqua*. (Ramsey's "Annals of Tennessee," p. 26.)

Some Epithets and Idioms in the Aboriginal Indian Names.—As an evidence that the early colonists of America—or at least those who named the rivers of the Continent—are really of comparatively modern extraction, we may cite the fact that their nomenclature abounds in adjectives and descriptive phrases, while the language of primitive men in remote eras, as stated in a previous paragraph, indicates only the briefest nouns and verbs. A great majority of the (apparent) epithets in the native American names have unmistakable identity with the Latin. Roman idioms and phrases are presented with very curious and interesting development in analyses of those names—especially names of some of the great rivers of the Continent.

The Roman term for great was the well-known word *magnus*. Its abbreviation in the Latin was *magh*, *ma* (or *mah*, which refers to its Sanscrit root. *Mak* is the brief transcript of the Greek synonym.) The letter M was sometimes used as an abbreviation.

Now it is a very various and striking fact that this letter M, or some other abbreviation of *magnus*, is in the native "appellation" of nearly all our great waters. It is, indeed, in the name of all, with the exception of those where the sublime idea is indicated by terms other than in *magnus*; or where there was some conspicuous natural fact so distinctive as to require illustration otherwise—as, for instance, in the case of the Orinoco of South America. I believe this word is simply *Orien aqua*—or the river that runs to the *Sunrise*. This is in perfect illustration of the actual physical fact; no other river in the world for the same distance runs more directly to the Sunrise, or to the *Oriens*, than the Orinoco. There is another river in North America that had originally the same Indian name—the *Orien(s)aqua*. It is a river that runs so nearly to the sunrise, that in an easterly course of over two hundred miles it crosses a single parallel of latitude six or eight times. Its ancient name has been corrupted to "Roanoke"; but if the student desires to find how the earliest explorers of Virginia and North Carolina wrote the word, the versions will be found in "Hawks' History of North Carolina." Local tradition preserves the original name yet in the famous "Oronoko tobaccou" that grows along this river.

These, indeed, are remarkable coincidences. The early Indian's mind was thoroughly scientific, and titles were truly characteristic. Definite expression, as we have stated elsewhere, was conveyed in the word coined. Hence, when a

river name was spoken, the audience at once knew the character of the water. This was the general rule, though exceptions appear. We cannot now determine the facts fully, because many of the descriptives of the Indian names are evidently gone from the more modern title. We know that even in the historical period many of these (descriptives) have been dropped. For instance, we have now simply "Mackinaw," where it was originally Michilli Mackinaw (or *Ma-aqua-na*). We have now in our geographies and on our maps simply "Haw," where the original was *Saxapahaw*—two well-known descriptives gone from the ancient name. We have also "Toe," where it was originally *Estatoe*. Numerous examples could be cited had we space for illustration.

The Latin birth of the descriptive in the examples given will be seen as we proceed.

Not only have the Indian names been often shorn of their strength and vigor by the abbreviative spirit of our modern age, but sometimes those names have been clad in the most fanciful of garbs by literary æsthetes. In a group of the fanciful names appear Tennessee and Mississippi.

Let us analyze the latter, as it is one of our great waters having in the title the letter M.[3] Before we proceed, however, with the task of analysis, we should formulate full principles upon which we can proceed legitimately, dealing, as we have to, partly with the absolutely unknown. There is a principle, well understood in the higher branches of mathematical science, applied in the elucidation of problems where, with a knowledge of three factors, the fourth or the unknown is an easy demonstration. In the case of the Indian names we often have undisputed facts in our favor. In the example Orinoco we have the illustration of a physical nature that cannot be controverted. Secondly, the fact that the Indians' words *mean* something—the fact that they have definite significance—certainly cannot be eliminated from the problems before us, if we have the evident descriptive epithet yet remaining with the name. We have also often the testimonies traditional. Fortunately the gap lying between the coinage of the word and its communication to our ancestors in the historical period was not so great but that the truths of history were often securely held in the memories of the native, and correctly transmitted. We should not, however, attach too great importance to mere tradition, unless it is corroborated by the physical and the verbal facts. If these, however, shall all agree, and a comparative investigation reveals a further coincidence and corroboration in the Latin language—in the Roman theory—we certainly must consider the evidence decidedly in our favor, if not irrefutably sustaining the positions assumed.

3 Among the waters of the Western Continent, having in their aboriginal titles the letter M, are Mississippi, Missouri, Merrimac, Potomac, Moratoc (lower Roanoke), Michigan, Kallamuckee (great Tennesse), We-apa-ma-ooka (Albermarle Sound), Ma-aqua-esque-don (Delaware Bay), Ma-aqua or Mahaqua (Hudson), Appomatoc (James?), Minnesota, Alabama, Amaccura (in Florida and South America also), Ammasona (Amazon), Vermaha (La Plata), Mackinaw (Lake Superior), and Wasmasaw (Cooper). Webster says that Massachusetts means "great hills." The tradition in regard to nearly all the names cited connects the term "great" with the words.

Applying the touchstones, let us begin with the Mississippi, the greatest of our rivers. There are many traditions in regard to this name. There is one—given in Barnes' School History—which gives the meaning as "the gathering of the waters." Certainly there is the great physical fact illustrated there—in the current of that mighty stream; the waters of nearly half a continent are "gathered" in its embrace. The physical and the traditional here agree. We encounter, however, a difficulty in determining the full verbal facts, for our learned men are not fully agreed as to the true word. Hence we are required to evolve or produce order out of the chaotic material found in historical and literary archives. The modern writing, "Mississippi," as previously observed, is a work of fancy. The original has been given as "Metche Sepe" by grave and learned authority; and "sepe" or "sippi," is a recognized term for river in the Indian. These evidently have origin in apa—the "epe" or "ippi" being mere corrupt pronunciations of the Wallachian word (apa). There are, I think, less than a dozen of the Indian river names now written in "epe" or "ippe;" while in scores of them the river term is rendered in Apa and Aba. Marquette, in 1673, gave the original word as "Metchi Sipi." The missionary Allouez, in 1665, wrote it "Messipi;" and one of transcripts of the river name given by De Soto, the discoverer, in 1540, shows "Mico" (or Meso).

The original name is evidently composed of two terms—the prefix being something which the early writers endeavored to transcribe as "Messe," "Messa" or "Metcha." A close scrutiny of all the testimony bearing upon the name—comparing it with the word Missouri—makes the true aboriginal name Messis-apa. We must take the name Missouri into consideration from the fact that geographers and geologists alike generally regard the Missouri as the true Mississippi. The Indian evidently took the same view of the rivers; for the two words are almost identical in origin and significance.

The descriptive in the names are pure Latin. They come from the verb *meto*, which means *to measure*, or to *gather togther*. In conjugating the verb these forms are developed: *meto*, *messis*, *messoi* (or messio). The latter means "the gathering." This epithet, joined with Sanscrit term Ri, which is indicative of the rapid, rushing current so characteristic of this river, gives us almost the identical orthography originally used (by our earliest explorers there) for the name Messuiri.

There are nice subtle differences in the two names—Messuiri and Messisapa—that betray in their coinage a mind schooled in science, not only the science of lexicography, but of geography and hydrography also. From Memphis down—say from the point where De Soto first discovered the river—the name Messis-apa truly applies. This word means, with the Latin theory in regard to the prefix—*the gathered water*. Above that point the river *is gathering into its embrace* the other great waters of the valley; and hence the legitimate application of the participle to the upper river, hence the *Messui-ri*—truly *the gathering river*—and not the "muddy river," as some authorities say the word means.

These are certainly striking, if not startling, testimonies revealing the In-

dian's knowledge of the mother (Latin) tongue. There is, without doubt, in them a corroboration of the three-fold facts—the verbal, the physical, and the traditional.

But these are not all the valuable facts in connection with the river that evince the Indian's knowledge. The Mississippi was known to the early aborigines also as the Chuckagua (Ramsay's Annals of Tennessee). This is the title, doubtless, which gave rise to the tradition that the meaning of the name was "Great Father of Waters." We see the term "water" in the word in the Spanish version of the Latin *aqua*. The expression "Great Father" is supposed to be represented or expressed by the prefix "chuc," which is furthermore supposed to be the same as the Hebrew Jah[4] (or Jehovah)—the Great Father. This Hebrew term, or its corruption, is often found in the Indian nomenclature, and written in transcripts showing now "Chi," "Che," "Chu," etc.: and what is more remarkable still, this term is nearly always in names applying to waters about which there is great mystery or grandeur. It appears to be a fact that the word Jehovah was once known in purity to the early colonists of America. The Choctaw Lexicon has it as belonging to that language. And that their word is not a mere modern appropriation or adaptation of the ancient one we have striking evidence. The Choctaws print it as "Chihowah." Now, an ancient tradition gives the aboriginal name of the Delaware River as Chihohocci (or really *Chihoaqua*). The legend (as recorded by Mrs. Ellett—Poems—Tradition of "Delaware Water Gap")[5] is that God's Finger—or the Finger of the Great Spirit,—once touched the mountain, at a place now known as Delaware Water Gap; the rocks were then rent asunder, and the waters released from their long confinment in the valleys beyond. Hence the name—simply God's River.

Reserving for a future article other illustrations of the Indians' use of the Hebrew term, let us return to those names wherein the Latin *magnus* or its abbreviation is seen.

There is a tradition, I think mentioned by the historian Bancroft, that makes the meaning of the aboriginal name of the Hudson simply "The Great River." The Hudson has had many tribal appellations, mere dialectic distinctions. But the title that appears to be the oldest, the one most in conformity with the recognized models of the aborigines, is the word Mahaqua. This appears first historically in connection with one of the oldest tribes along the river (see Am. Cyclopedia, vol. I., p. 188.) But it is a well known fact that the aboriginal nations usually received their tribal distinctions or appellations from the name of the river upon which the people were first found by the early white explorers here. This is in accordance with a custom which has obtained in all ages of the world. The conclusion is therefore legitimate that the name Mahaqua was first applied to the river. We are supported in this conclusion by all the historical facts pertaining to the name. The same name lingers still in a corruption of the old

4 In the Spanish language—from which we get the Indian originals—Ch and J are the same in sound.

5 Citation made from memory—the authority not at hand at this writing.

word, a name which applies yet to a tributary of the great river. This corruption is the word "Mohawk." Other corruptions of the ancient names exist in "Mohegan" and "Mohican" (which are identical, illustrating an outgrowth from the primal word, and illustrating also the kinship between the terms Ogha, Acha and Aqua.)

The name Mahaqua is pure Latin—acknowledging the prefix "Mah" to be but the Latin abbreviation (Sanscrit root) of the word *magnus*. We have not space in this magazine for analyses of all the native Indian names showing the abbreviations of the Latin *magnus*. There is one illustration, however, we cannot omit in this paper. The early explorers of the coast lands of North Carolina and Virginia found the natives almost everywhere in their discoveries using the term "Occam" (or *aquam?*) in referring to large bodies of water. (See Hawks' History of N. C.) A large Carolina lake is now known as Waccamaw (*Aquamah*).

The word "Occam" illustrates a distinct Latin idiom—the Latin being one of the few dead languages that allows the terminal in a consonant: the Greek forbids it. There are many Latin idioms illustrated curiously in the Indian names. We shall cite some interesting examples before closing this paper. Before proceeding with them we desire to notice a group of names revealing a descriptive about which there can be no question as to its legitimate location in the Latin language, if comparative illustrations and analyses can demonstrate truth.

In some of our northwestern States the term "Minne" is often found in the the native Indian names of waters—as Minnesota, Minneoah, Minnewaukin, Minnetonqua, Minnehaha, etc. It is evident that there was some conspicuous natural fact which gave birth to the expression "Minne" in the mind of the early aborigines.

What was this fact? Science, with its many voices, gives utterance to eloquent truths in our behalf. Geology and physiography enfold their testimonies. The blunt, plain English pioneer of modern times pushes into that same northwestern country, and everywhere the same suggestive natural facts present themselves, and they are marked down on our maps in the terse and vigorous expression of *his* vernacular—simply *the Red*, or *the Vermillion*;—and if we look into the geographical literature of the country there, we shall find "the Great Red River" (of the North), "Vermillion Lake," "Red Lake," etc. Underlying the country are vast deposits of *red* clay, *red* sandstone, and *vermillion* earth. Many of the waters there have in consequence the *reddish tinge*. These are the natural facts so prominent and suggestive there. They were equally impressive upon the mind of early pioneers whether in the few decades ago or in the far centuries gone by. Each of these pioneers took from his vernacular its most expressive word, and left it as a perpetual memorial of birth and origin. And if we open our authorities on language, we find in the Indian "minne" merely the Latin *minio*, which in plain English means precisely the *red*, or the *red vermillion* clay.

It would be difficult to find verbal testimonies more conclusive than in those

Minnesota names. There is not in them an isolated expression of a fact—the evidences are numerous and unmistakable. And yet if we attempt a more careful analysis of some of the names we are met with cumulative testimonies. The legend says that Minne-ton-qua means "thundering water." The Latin has *tono* for thundering—and the "qua" is but abbreviation of *aqua*. Minnehaha reveals one of the Roman idioms referred to in a previous paragraph. The word contains, as a term for river, the Teutonic Aha, the equivalent of Celtic Acha. The name is supposed to have applied originally to what is now known as the "Great Red River of the North." It is no unusual occurrence for an interchange of names to be found in our growing country. In more modern times two of the Texas rivers have changed names. The Brazos was once known as the Colorado, and the present Colorado was known then as Brazos. Other examples could be cited. The poetical associations of Minnehaha have had much to do in its history. (I would not detract from the memory or fame of the grand old bard who has immortalized that word; rather would I lay additional honors about his own immortal name.)

In analyzing the word Minne-h-aha we discover what might appear as a superfluous h, yet, if we are right in our conclusions, the letter is there for a definite purpose. It is there as an expressive factor in the name. If we were to suppose the name meant simply "red water," we should perhaps do injustice to the Indian's art and knowledge. Let us probe the problem deeper.

By reference to our standard authorities on the Latin language, we find that the letter H is often the abbreviation of the word *habeo*, which, with most vigorous translation, means *to hold*. The word Minnehaha would therefore mean, with a liberal construction, river that holds red or vermillion clay. This is demonstrated by the actual physical facts:—the waters do hold the red element for a long distance.

Have we other examples illustrating this idiom? In the Southern States are many rivers that flow through low alluvial soils and often in banks of a loose, friable clay. These banks are continually "falling in,"[6] and hence the waters are always muddy. The Talla-ha-chie is a noted illustration. We have the river term in this word in the Celtic Acha. The intermediate H indicates the *habeo* or holding the *talla*. What is "talla"?

A reference to our Latin shows us that *terra* and *tella* are identical in that language. The Southern Indians very rarely used r: and "talla" is but a corruption of *tella*, the earth, or the earthy débris held in solution in these muddy southern rivers. Those who know from observation the character of those rivers, know that this earthy débris (represented by the "talla") is one of the distinguishing features of those rivers.

One of the Alabama rivers which is always muddy (where I have known it) is the Talla-p-oosa. This word is replete with suggestiveness and truth. The

6 Tradition says Monongahela means "falling-in-bank river." The suffix "ela" is easily located in the Latin *elabor*, which means to *fall out*, or *slip away;* hence the Indian "falling in." Our English word *elude* perhaps has same parent.

river term here is "oosa." This is considered an old Saxon word for water (see Webster—"ousa"). It is, however, found in ancient river nomenclature in every quarter of the world. It is often in the native Indian names. It is doubtless a corruption of either Acha or Ogha.

We see in the name, as we have it divided, Talla p-oosa, three factors; a descriptive prefix in "talla"; with the suffix "oosa," an acknowledged river word. What are the functions of the other element in the word—the simple letter p? Indisputable testimonies give response to our query.

First, what is the other natural fact in connection with this muddy river? It is a very *powerful* stream. The immemorial legend says that the word means a "swift current" or "swift water." Well, swift waters are generally waters of power. But do the verbal facts coincide with these testimonies? Opening our Latin authorities again, we find that this letter p is a recognized Roman abbreviation of the word *pondo*, which means powerful. These are facts which the most skeptical cannot reject.

This tell-tale letter P—like the neighboring one M—is a curious exponent of verbal and historical facts. It is found in many native Indian names where the rivers are rivers of great available waterpower. (All great rivers have a certain element of "power." But we are now considering the available feature of that power.) Some of the most noted rivers in America, where the motive power is developed or available, have this letter P in the title. The Potapsco is the most powerful river of Maryland. The Saxa-p-ahaw turns more machinery than all the other North Carolina rivers. The Winnepeg, the Winnepesocket (or really the *Winne-pisc-aqua*), the Penobscot, the Rappahannock, the (Upper) Potomac, and many others having the letter P in the Indian name, are all noted for their water powers.

(The Potomac betrays either Greek origin [in *potamos*—river] or in *poto* and the abbreviation of *magnus*—*mag* or *mac*. Virginia has many rivers that reveal both Latin and Greek in their "native Indian names." There are for instance Fluvanna [from the Latin *fluvius*—river] and also Rivanna—from *rivus*, another Latin word for river. Rapidanna and Rappahannock also show Latin words.)

There are some very interesting and suggestive facts in connection with several of the examples cited in the above paragraphs—independent of the mere Latin theory. Let us indicate specially the Saxa-p-aha, the Penob-scot (or the *Penapsca*) and the Potapsco. The former contains the pure Teutonic term Aha, and also the Latin root of our English word for rocky—*Saxeum*. This Latin word, however, has its remote origin in the Sanscrit *Sax*, or *Ska*.

Scholars are familiar with the derivatives of the Latin word *Saxeum*, and the Sanscrit term *Ska*—such as "rough," "rocky," "stony," "scabby," "scaly," etc., etc.

Now if we investigate the character of the waters, their channels, etc., in America, having in their names either of the terms, the Sanscrit *Ska* or the Latin *Sax*—which, as we have observed, are identical—we are met with the startling fact that they are among the very roughest and rockiest on the continent. The

axapahaw is one of the roughest and rockiest rivers in N. C.,—the ledges of ranite over which the waters break aiding in developing the immense power of ie river. The Saxatchawan (with its Celtic Acha) is the rockiest and most powrful river in the British American possessions. The only river in the Gulf States aving a native Indian name that contains the term *ska* is so proverbially rough iat in common English parlance it is known as "the Flint" (of Alabama). The boriginal name is Thro-na-dee-ska. Two ancient river terms are revealed in iis word, in addition to the unknown prefix and the Sanscrit suffix.

The Sanscrit suffix is in many native Indian names; but it is rendered in arious (modern) orthographies. "Ska," "sca," "scaw," "sco," "scow," and scot" are all versions of the one true word—the latter (scot) supposed to be anriginal French rendering, the final *t* silent. The term ska is often in old nomenatures, especially in the rough and frozen regions of Europe and Asia. In ddition to the American words already mentioned, we see it in Nebraska, laska, Yamaska, Athabaska, Caniapascaw, Androscoggin, and in numerous thers. (The latter name is correctly written Ame-ri-sca-gan.) The Caniapasaw is variously written. It is sometimes given as Caniapuscow. It is well nown, however, that all the existent orthographies for our Indian names are hiefly conjectural and fanciful. The various writings are but the efforts of scribes give transcripts of the syllabic sounds contained in the words. There are no ommon and universal methods of expressing in written characters all syllabic unds—especially the sounds of a foreign tongue. This fact has given rise to ifficulties long recognized and wide-spread in literature, and especially geograph-al literature; and also in the nmenoclatures of the human families. It is well nown that the transcripts we have for nearly all the words in Oriental languages o not correctly represent the names as they exist in the native speech. Examiation of our "authorities" on the Indian language shows the uncertainties that xist in the minds of our learned men in regard to aboriginal American names. Ve often find several transcripts of one word recorded in order that the reader ay recognize the difficulties encountered in arriving at the true othography. he etymology of the Indian language is yet to be reduced to a science; its present orthography is but a field of conjecture, as we have seen.

To illustrate this fate we cite a name which has been written in one of the revious paragraphs as the Winne-pisc-aqua. Our authorities say that *Winniiseogee*, *Winnepisockee*, and *Winnepesocket* are all recognized methods of writing ie word. The latter with its final *t*, betrays the hand of a French writer. We esire to notice in a future article the terms in this name more fully, giving our asons for writing the word differently from modern geographers. For the present, we wish to discuss further the diverse methods of expressing in English the llabic sounds in the Indian.

There is a corruption of Acha (aka, with the hard sound) often found in the ver nomenclatures of the world with an expression, rendered, in English *pronunation*, as *eka* or *ekuh*. It is variously *written* by geographers as "eco," "ico," ika," "eque," "ega," "ucuh," "ucah," "aga," etc. In the Russian language

the word for "river" embodies the same sound heard in this corruption of Acha. That Russian word is transcribed in English as *reka*, *raga* or *rega*—the *r* merely an abbreviated expression of the Sanscrit Ri.

Names that are typical[7] of countless others in the Indian language are written in our geographies Cocheco, Oswego, Topeka, Canecuh, Mexico, etc. The latter name was once written Mexique. The fact is, this is the present French writing of the word. Megico or Mejico is the Spanish orthography.

Our wise men have speculated long and unwisely over the origin and significance of the word Mexico. Let us but remember that it comes to us first through the Spanish. That Spanish word, as we have seen, was Mejico (or *Mejaquo*). The "Mej" in this word is but an expression of the syllabic sound heard in the Spanish or Latin pronunciation of the word *medius*—just as we often hear the syllabic sound in "Ind-ian" rendered *Inj-un*, or *In-jun*, in English pronunciation.

This gives us a key to the long-sought mystery. Other science comes to our aid again. We consider the physical facts pertaining to Mexico. This strip of country is *between the two great seas*—it lies *in the midst of the water*, or in plain Latin, *media aqua* or *med-aqua;* and hence Mej-aqua, or Mexico.—*Magazine of American History*.

MODELS OF THE PREHISTORIC PUEBLOS OF NEW MEXICO AND ARIZONA.

Col. Stephenson, who has for several years devoted his time to a systematic research into the mode of construction of the Pueblos of New Mexico and Arizona, started for the scene of his labors again last night. He will continue the work of last summer and will make a general ethnological collection illustrative of the customs and condition of the arts among the present Pueblo Indians. One of the most interesting features will be a collection of pottery, of which these people make a great variety, skillfully decorated and of elaborate and tasteful designs. Much of the material will be sent by the bureau to the New Orleans Exposition.

The National Museum in which the offices and workshops of the bureau are situated, is being rapidly fitted up for the purpose for which it was designed, but there are still odd corners fenced off from the public gaze. In one of these divisions a number of workmen are engaged under the supervision of Mr. Victor Mindeleff, constructing a series of models of seven pueblos of the Province of Tusayan. These towns are Te-wa, Se-chom-a-vi, Wol-pi, Ma-shong-ni-vi, She-pan-el-e-vi, Shi-mo-pa-vi and O-rai-be, which were visited by the Spaniards about the year 1540, and are still inhabited by descendants of the Indians whom Coronado then saw. These models are being made from the most accurate measure-

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7 Onega is a typical Russian name. Tanganika contains a typical African expression. Stanley says that the word Tanganika means in the African dialects "great lake."

ments and plans, supplemented by sketches and photographs of every detail which were secured during the field season of 1883. The models are all being made to a uniform scale sufficiently large to show distinctly all the minor features of the architecture and construction that have been followed from time immemorial by those interesting and secluded groups of men. They represent very faithfully the character of the masonry in color and texture. Many experiments were tried before a substance could be found that would properly represent the originals in this respect, and at last a species of papier mache, the basis of which is macerated greenbacks from the Treasury Department, was hit upon. The seven towns which it is the purpose of Mr. Mendeleff to portray are built upon the mesas or table-lands of the mountains of Arizona, all upon the same plan. Walls of stone cemented with mud support beams upon which boughs and dried grass are placed and covered with a cement formed of mud. The houses are generally rectangular in shape, and are built to a height of four or five stories, in the form of terraces, one upon the other. Originally there were no means of ingress or egress upon the ground floor, admission being gained through doors in the second story, reached by a ladder, which was drawn up in time of danger. Recently, however, since the advent of the white man among them, some doors have been cut in the lower stories. The seven models described are nearly completed and will be sent to the New Orleans Exposition.

A series of models of the ruins of the cliff dwellings and the remnants of other prehistoric architecture is being prepared from the data secured during last season's field operations. The cliff ruins referred to occur principally in Cañon di Chelly, in northeastern Arizona. These cañons have been formed in a soft stratified limestone, in the present instance to a depth of nearly 1,000 feet. In the bottom of the chasm a small stream known as the Rio de Chelly is found. Overlooking this stream, and perched upon the hardened ledges that have been left by the erosion of the sandstone, are seen numerous cliff ruins, varying from a single room to clusters that would easily accommodate several families. These are usually found grouped around a central ruin or small pueblo, which is built upon the flat of the cañon bottom. One of the models in course of preparation illustrates one of the ruins of this latter class, with its cliff-dwelling overlooking it. Wherever the action of the weather has formed a recess or alcove in the vertical rock face these ancient builders have selected a site for their curious inaccessible structures. The architecture of the prehistoric rates, as well as the pottery found among the relics, surpasses in design and construction the work of the modern Pueblo Indians.

All of the models will be sent to New Orleans, and when the Exposition closes there they will be returned to the National Museum. They will undoubtedly attracted a great deal of attention, as they are the only ones of the kind ever exhibited. One model was made last year and is one of the chief objects of interest in the museum to-day.

The seven towns mentioned above are inhabited by the Moquis Indians. They number about 2,000 souls and are dependent upon agriculture and sheep-

raising for their existence. The Government makes no provision for the Pueblo Indians in the regular appropriation bills.—*N. Y. Evening Post.*

ANTIQUITY OF MAN IN AMERICA.

PROF. F. W. PUTNAM.

[*Reprinted, with slight changes and addition of note, from Proceedings of American Antiquarian Society, at Semi-Annual Meeting, April* 30, 1884.]

Frederick W. Putnam, Curator of the Peabody Museum of American Archæology at Cambridge, made a few remarks bearing upon the antiquity of man in America, based upon objects recently received at the Museum.

He presented photographs of four blocks of tufa each containing the imprint of a human foot. These blocks were cut from a bed of tufa sixteen feet from the surface, near the shore of Lake Managua, in Nicaragua, and were obtained by Dr. Earl Flint, who has been for several years investigating the archæology of Nicaragua for the museum and has forwarded many important collections from the old burial mounds and shellheaps of that country. The volcanic materials above the foot-prints probably represent several distinct volcanic eruptions followed by deposits of silt. In one bed, apparently of clay and volcanic-ash, six and one-half feet above the foot-prints, many fossil leaves were found. Specimens of these are now in the museum and their specific determination is waited for with interest. While there can be no doubt of a great antiquity for these foot-prints, only a careful geological examination of the locality and a study of the fossils in the superimposed beds will determine whether that antiquity is to be counted by centuries or by geological time.[1]

1 Since this notice was printed in the volume of Proceedings the Museum has received from Dr. Flint a representation of a vertical section of the quarry 300 yards from Lake Managua, as follows:

Surface soil,	12 to 18 inches.	
Hard Tufa,	20 "	
Seam,	— "	
Hard Tufa,	20 "	
Seam,	— "	
Hard Tufa,	17 "	
Seam of black mould,	— "	
Compact Tufa used for building purposes,	28 "	
Seam of black mould,	— "	
Hard Bluish-ash and Clay, containing fossil leaves,	14 "	This layer increases to 15 feet to the South and South-West.
Hard yellow Clay (native name *Tal-petate*),	12 "	
Scattered Pumice,	2 "	Variable.
Sand,	7 "	
Compact Tufa used for building,	47 "	
Seam,	— "	
Compact Tufa,	6 "	Variable, 5 to 7 inches.
Dark Sand,	1 "	
Hard Tufa, dark,	2 "	
Sand,	1 "	

He also exhibited a portion of the right side of a human under-jaw which was found by Dr. C. C. Abbott, in place in the gravel, fourteen feet from the surface, at the railroad cut near the station at Trenton, New Jersey. It will be remembered that in this same gravel deposit Dr. Abbott has found numerous rudely made implements of stone, and that in 1882 he found a human tooth about twelve feet from the surface, not far from the spot where, as he states, the fragment of jaw was discovered on April 18, 1884. Both the tooth and piece of jaw are in the Peabody Museum, and they are much worn as if by attrition in the gravel. That they are as old as the gravel deposit itself there seems to be no doubt, whatever age geologists may assign to it, and they were apparently deposited under the same conditions as the mastodon tusk which was found several years since not far from where the human remains were discovered. While there is no doubt as to the human origin of the chipped stone implements which have been found in the Trenton gravel, a discovery to which archæology is indebted to Dr. Abbott, the fortunate finding of these fragments of the human skeleton add to the evidence which Dr. Abbott has obtained in relation to the existence of man previous to the formation of the great Trenton gravel deposit.

MEDICINE AND HYGIENE.

THE GERM ORIGIN OF INFECTIOUS DISEASES.

H. R. PAYNE, M. D.

It must be the common observation of every thoughtful person that we are living in an age of great progress, and that the learned theories and traditions of the past are rapidly giving way to the new lights of to-day. We see this to some extent in every department of learning, we see it in the sciences, and especially so, when applied to the art and science of medicine.

Medical history in the early ages advanced from the time of Hippocrates, to that of Galen; in the dark ages it receded; upon the revival of letters, as in other departments of learning, it emerged from the general gloom. In the early part of the seventeenth century Harvey discovered the circulation of the blood; in the following century Jenner made his great discovery as to the protective power of the vaccine virus, at about the same time Galvani achieved a world wide reputation as the discoverer of galvanism; Faraday followed him by making additional discoveries in electricity and electro-magnetism; in materia medica, perhaps, the

Foot-prints on Surface of Compact Tufa (quarried for building purposes). This bed of tufa is forty-seven inches thick and rests upon the original soil, containing stems and leaves; probably the former level of the lake.

← 15 feet 9 inches to 16 feet 3 inches of materials above foot-prints.

great majority of medical men will admit the great benefit that quinine has conferred upon the human race; valuable instruments have been invented for the detection of disease; to sanitary science all honor is due, as it has greatly prolonged the average period of human life, and in the last few years has kept fully abreast with the spirit of the times.

But notwithstanding all these improvements and discoveries, the same progress has not been made until recently in the etiology of disease. It must be acknowledged that the *causes* of disease, and the understanding of them, lie at the very foundation of successful medical art. Without this knowledge the physician is left to his own speculations, or follows the lead of some able authority who has boldly marked out new channels of thought, and whose theories (too often metaphysical) have attracted adherents from all parts of the world. In this way theories after theories have arisen, which have controlled the minds of men, and perhaps for a generation became the established principles which guide in the treatment of disease; we have only to refer to the practice of bleeding, so ably championed by the great and good Dr. Rush of this country, which was only discontinued when it was found to be not only unnecessary, but positively injurious in very many cases. Following this radical treatment came the revival of the old but somewhat modified expectant method, which is practiced by physicians in very many cases down to the present day. It consists in waiting and watching for the manifestations of the disease, and meeting the symptoms, and combating them by treatment as they may arise, supporting the patient for the approaching crisis, but relying very much upon the recuperative powers of the system to expel the cause.

These frequent and sometimes violent innovations, naturally produced sects, or systems of medicine, which as the world knows have fluctuated from one extreme to the other. During this conflict of opinion as to the cause and treatment of disease, scientific men have, especially of late years, been engaged in a spirited discussion as to the origin of life; the desire of men to understand it has been a subject of great inquiry for a long time. Some have contended that life had its start from inorganic matter. Ernest Haeckel, the philosopher, is a firm believer in this theory; he goes so far as to claim that as carbon, oxygen, nitrogen, iron, sulphur, etc., are found in inorganic nature, and the same elements are also found in animal and vegetable life, therefore, that all life must have originally started spontaneously from the union of some of these elements; so firmly was he convinced of this that he prevailed with his government to appoint a commission, himself at its head, to settle the question; but after long and repeated trials the commission closed its work without accomplishing anything. This theory is not only accepted by many medical men, but some of them have applied it as the cause of disease, and believe that at least all of the epidemic and contagious diseases originate from spontaneous generation; they believe that the specific poison arises from the decomposition of dead animal or vegetable matter and is diffused in the atmosphere and thus affects great numbers of people; or that it may be generated in the body of the diseased, or dead subject, and contracted by those

persons who are exposed to, or come in contact with it, and that the life, or germs found present in such cases, are spontaneously generated in the body and are the effect, and not the cause of the contagium. Dr. Bastian, of Germany, and Hughes Bennett, of Great Britain, not only believed this but made many experiments with various animal and vegetable infusions, to prove that life can be started from matter entirely destitute of life, and so conclusive did the experiments appear that many were induced to accept the theory as true. But these experiments were shown to be defective, and that the life that swarmed from the infusions, did not come from the inert matter, but from the minute and invisible germs in the air.

While these views are still entertained by many authorities, they are antagonized by the ablest scientific men of the world; they have proven from their recent discoveries that some of the epidemic, or infectious diseases start from germ life, and so convincingly have they shown this, that perhaps the majority of medical scientists now believe that all of these diseases originate from the same cause, and that no infection can start from matter that is destitute of life.

It was Schwan, of Berlin, who some years ago discovered that the yeast-plant was a living vegetable germ, and that when plowed in favorable conditions reproduces itself indefinitely, and that if the germ or life in the yeast is destroyed there can be no fermentation; he also showed that meat exposed for any length of time to an absolutely pure air will not take on putrefaction, but that when exposed to the life that is in the air putrefaction soon follows.

But the discoveries of M. Pasteur, of Paris, were the first that aroused general attention to the subject of germ life. It was in 1865 when he commenced a series of experiments which have culminated in placing his name in the front rank of original investigators. It may not be generally known that the silk culture has for a long time been one of the leading industries of France; in 1853 it produced a revenue of one hundred and thirty million of francs, in 1865 it was reduced to eight million of francs, the cause was supposed to be some disease which affected the silk-worm and finally destroyed it; large sums of money were offered by the government to any one that could find a remedy that would stop its ravages, but all efforts proved of no avail. Pasteur at this time commenced his work to unravel the mystery. After long study and many experiments he at last discovered with the aid of his microscope, that the cause of the disease was a living parasite; he found that the parasite first attacks the moth, the moth lays the egg which being affected, is transmitted to the now forming silkworm; he communicated his discovery to the Academy of Sciences at Paris, and by his careful selection of healthy moths and eggs, this great industry was restored to its former prosperity. Three years before this time his attention had been directed to a disease prevailing in the vineyards of France: the grapes became diseased, and the wine produced from them was so injured as to cause a loss to the country of many millions of dollars. He discovered the cause to be a parasite; after learning this, he found from further experiments that by heating the wine to temperature of 50° C. its purity was fully restored.

Tyndall, of England, had for a time halted in opinion between these contending forces, but Pasteur's experiments added to the previous discoveries of Schwan led him as a true scientist to make experiments for himself. They were carried on for a long time, not only in his laboratory but in different parts of England and Scotland, in valleys and on the tops of the highest mountains. He selected different animal and vegetable substances, many of them the same that were used by Dr. Bastian and Hughes Bennett in their experiments; they were each separately digested at a temperature of 120° F., for from three to four hours, then filtered and boiled, and each separate infusion was poured in glass jars so carefully as to admit of no air, and hermetically sealed. He found that these jars could be indefinitely exposed, and the infusions show no signs of life, but continue to retain their clearness and purity; one hundred and twenty of these jars were exposed for three years, showing no trace of life; but when the smallest opening was made, so small that the natural eye could not detect it, and the air with its living matter admitted for the shortest time, in from two to four days the infusions became cloudy and soon swarmed with bacterial life. As the result of those prolonged experiments he affirms "that in one day life has never been known to arise independently of pre-existing life, I belong to the party which claims life as a derivative of life." His experiments have been confirmed by Pasteur, Huxley, Helmholtz, and others.

About this time Lister, the great surgeon of London, began to see that this germ-life must be the great cause that prevented the healing of wounds in his hospital practice; he changed his course, and by the introduction of his antiseptic treatment, has brought about a revolution in surgical practice, and such fatal complications as erysipelas and hospital gangrene will become almost unknown when his instructions are fully carried out. Had this treatment been introduced earlier, thousands of lives would have been saved, during the late war, in the large and crowded field hospitals of this country.

At this stage of medical progress the scientific world has reached a point of absorbing interest. The microscope, that wonderfully perfected instrument, has revealed to the gaze of man its countless array of infusorial life, and is wresting from nature many of her hidden secrets. Pasteur and Koch, Cohn, Klebs, Crudeli, and other careful investigators believed from their experiments that many of the infectious diseases of the human race and animals are caused from germ-life, but it was Koch, of Germany, who scored the first great success in discovering the parasitic cause of disease in the human subject; he had previous to this detected their presence as the cause of splenic-fever in cattle; after completing his study of this disease he turned his attention to tuberucular consumption and discovered what he calls a "rod-shaped bacillus" in all genuine cases of that disease; from long and repeated experiments upon different animals he at last became convinced that these organisms are the cause, and that they occur constantly in persons who are suffering from the diseases and that they are distinguished by peculiar features from all other minute organisms. He says that "it

is a specific infectious disease caused by a specific micro-organism which constitutes in fact the true tubercular virus."

These views are opposed by some of the ablest men in the medical profession, among them Dr. Formad, of Philadelphia, who admits the presence of the germs, but believes they are the effect and not the cause of the disease; the discussion is still going on but the most distinguished pathologists of both hemispheres acknowledge his discovery and accept his conclusions; the veteran Austin Flint, Sr., of New York, being one of the number. At the last meeting of the American Medical Association at Washington, as its president, he announced his concurrence in Dr. Koch's discovery.

But we must again turn to Pasteur, of France, who has taken another step forward in this new field of study. Over four years ago he commenced his work to discover the cause and prevention of hydrophobia; his past experience had led him to believe that in the virus of many of the infectious diseases was to be found the means to guard against the infection; that is to say—by introducing into the body of a healthy animal by inoculation a similar, but attenuated virus, it will prevent the danger of the infection when exposed to it. He commenced his experiments in the following way: A monkey was selected and inoculated with the microbe, or virus of a rabid dog; the animal died, he repeated the experiment by taking the virus from the dead monkey and inoculating a second one, taking the virus from this second one he repeated it upon a third monkey, and then found that it was almost innocuous; he then took the weak virus and inoculated a rabbit, and found its power increased, this last was then used upon a second rabbit, and he found its intensity still more increased, the virus from the last was then used upon a third and fourth rabbit until it had reached its greatest strength. With this modified virus, varying in degrees of strength, he inoculated healthy dogs, then after a time exposed them to the bite of the rabid animal, and found that the bite did not affect them; he then selected forty-two healthy dogs, twenty-three of which were inoculated with this modified virus; they were after a time allowed to be bitten by the rabid dog; not one of them had the hydrophobia; he now exposed the nineteen dogs that had not been protected by inoculation; out of the number fifteen soon became rabid. After fully satisfying himself as to its protective power, he made his report to the Academy of Sciences at Paris, he also attended the meeting of the International Medical Congress at Copenhagen, Denmark, and on the 11th of last August that body listened to his address, and he repeated the experiments leading to his discovery in detail; the latest reports from Paris, recount his final and complete triumph. A commission of seven members was appointed by the Academy of Sciences to fully examine into the merits of his discovery; the commission repeated his experiments, and have made their report, that he has succeeded in protecting against the virus of hydrophobia.

Now many, at first thought, may regard this discovery as of no great significance, because so few persons are bitten by the rabid dog, but when we reflect that it establishes a great law which further experimentation may show is appli-

cable to other infectious diseases; it makes the question one of the greatest importance. We know now that small-pox originates from germ life and that the vaccine virus, by inoculation prevents it; we have every reason to believe that yellow-fever comes from the same cause and that it is this germ-life that gives it its deadly specific contagion. Dr. Freire, of Rio Janeiro, Brazil, who has had much experience with yellow-fever, claims that he has discovered the microbe of that disease, he reports that he has inoculated four hundred persons with the attenuated virus, and that they remained protected when exposed to the disease. Further reports upon this subject are looked forward to with great interest.

When Hahnemann, the founder of the homeopathic system of medicine announced his theory of similars or "like cures like" almost one hundred years ago, it met with bitter opposition and ridicule from the great body of the medical profession in Europe and in this country, opposition on account of the principle of the theory, and ridicule because of the great attenuation of his remedies; were he able to rise from the slumbers of near half a century he would no doubt be much surprised as well as gratified to find that the foremost leader of medical thought in the world, has by the most laborious study demonstrated *as a great truth* that the cause that will produce a disease will, if attenuated, and used by inoculation in a healthy subject, remove the condition which gives rise to the disease.

But it will be seen that while Pasteur's experiments give great weight to the theory of Hahnemann, that his attenuations are not as great, and that when carried beyond a certain degree of strength, the virus loses it power to protect against the original cause.

In further confirmation of the germ origin of disease we have the testimony of Dr. Crudeli, of Rome, Italy. In his address before the late Medical Congress upon malaria, he shows from his experiments with other co-workers that the cause is a living specific ferment, contained in the soil, and that three conditions are necessary to its production "first, the proper temperature; second, humidity of the soil; third, the direct action of the oxygen of the air, acting upon the vegetable ferment; these conditions acting together will increase the ferment and cause its depression in the surrounding atmosphere." In his experiments covering a period of over five years, he found that the germs were in the air, the soil, and in the blood of the subject suffering from malaria.

The germ cause of disease has also been found in purulent ophthalmia, an infectious disease of the eye, occurring in new born children, as shown in a translation from the French by Dr. Tiffany of this city, and published in the *St. Louis Medical Journal* for August. As the result of this discovery, the disease has been almost extirpated in those hospitals, where the treatment for the destruction of the parasite has been adopted.

But general public attention had not been directed to this subject until the recent disclosures of Dr. Koch in his study of Asiatic cholera, it was natural that the appearance of this disease in France would arouse the fear, and excite the curiosity of the people on both sides of the Atlantic. It may be known to most of your readers, that France and Germany each sent a commission of medical

men to Alexandria, in Egypt, to ascertain if possible the cause of the disease; during the prosecution of their work one of the members of the French commission died; this unfortunate event put a stop to their work. The German commission, led by the indefatigable Koch, not satisfied with the study of the disease in Egypt, went to the cities of Bombay, and Calcutta, in India where it was confronted in its original home. When the cholera broke out at Toulon, and Marseilles, in France, the commission went to those points, to learn whether it was the same disease that prevailed at Alexandria, and in India. After spending some time at these places, the commission returned to Berlin. Dr. Koch was invited to meet in conference with the members of the Imperial Board of Health, the object of the meeting being to get his views of cholera; he explained at some length the work that had been accomplished; he discovered the comma-shaped bacillus, or a parasite of a comma shape, which he found much smaller than the rod-shaped bacillus of tubercular consumption; he not only discovered this, but he found that they often form into long spiral curves which he called "spirillum." Under favorable conditions these organisms grow rapidly, and when cultivated, and seen in one drop of meat infusion under his microscope they swarm in great numbers; they not only attain their growth rapidly, but they as quickly die; there are many agents which he found destructive to these germs, as camphor, carbolic acid, quinine, sulphate of copper, but by far the most destructive is corrosive sublimate; he says that they are readily killed by drying. He also says that the cholera bacillus is never found in connection with any other disease than cholera, and he is firmly convinced "that the cholera process and the comma bacilli are intimately related, and there is no other conceivable relation, but that the bacilli precede the disease and excite it." For my own part said he "the matter is proved that the cholera bacilli are the cause of cholera."

He further says that the virus can be multiplied indefinitely outside the body, but does not think it can grow in rivers, or streams where the current is rapid, but it grows at mouths of drains, standing or stagnant water, and that any animal or vegetable refuse in such places will not only hold but nourish it; subsoil water also propagates it from the same cause; the disease has a local habitation and that "all great epidemics of cholera begin in South Bengal where the conditions for the development and growth of the bacillus are most perfect.

It is only upon the theory of the germ origin of cholera that we can satisfactorily explain the outbreaks that occur in isolated places, or particular districts in a city, or the country, and while it may attack high or otherwise healthy places, it is well known that the fatality is much greater in low, damp and impure localities. It will be recollected by some of the older citizens of Kansas City that when the cholera prevailed here in 1866 it was almost entirely confined to places where all the surroundings were favorable to its spread, and where the water supply was mostly from springs, or surface wells. In one large house near the Missouri River with many occupants, the disease broke out and many died, the house was vacated and supposed to be cleansed and disinfected, it was soon after reoccupied, when the disease broke out afresh, and with as great fatality as

it first. From our experience with this disease in the past, and from the ravages which it has already made in parts of France and Italy, we have reason to believe that it will not only spread over Europe, but that it will reach this country, if urgent measures are not taken to arrest it; as the season is far advanced it may not touch our shores until the early part of next year; the different cities on and near the Atlantic Coast have organized strict sanitary regulations to prevent it. Has Kansas City been placed in a proper state of defense? Under the able management of the head of the health department, the health of the city for the last two years has been very good, the annual mortality list is so low as to make it almost unexampled, but there remains much to be done to guard against epidemic disease. His timely warnings and suggestions should be heeded and his arms strengthened with the means necessary to place it in a good sanitary condition. If this is not done, the city may suffer a calamity in loss of life and business such as it has never experienced.

The field of medical investigation which we have briefly presented to your view in this paper, is one of great extent; and the facts, but recently developed are too complex to be fully settled by the labors of a few men. Pasteur and Koch have, by their discoveries, already placed their names high upon the scroll of fame, they have opened the way through which will continue to flow the richest benefits to the health and happiness of the human race; but it should be recollected that new-born truths encounter opposition, and cannot in the very nature of the mental constitution of men, be generally accepted in a day.

The signs of the times indicate that the different branches of scientific medicine will be consolidated and crystalized into one harmonious system, the rough places will in time be made smooth. The various processes that will bring about this desirable result are quietly at work, and will make it, at no distant day, an accomplished fact.

KANSAS CITY, MO., October, 1884.

CONCLUSIONS REGARDING THE WARING SEWERAGE SYSTEM.

(*Translation from M. Pontzen.*)

The first application of sewerage according to Waring's system, made in Paris in 1883, in a quarter where all of the unfavorable conditions are combined, has been a complete success.

The establishments drained by Waring's system leave nothing further to be desired in a sanitary point of view, and the *ensemble* of the drainage works has not, during the five months it has been in operation, given rise to the least complaint. The water-closets in the courtyards are no longer offensive, and their presence would not be suspected, the conduits of the system have never required any special cleansing, no deposit has been formed in the collecting sewer in the Rue de Rivoli at the mouth of the main, and the air in this main, constantly

renewed and passing only over recent matters moving in a rapid current of water, has no odor.

The officers of the city and the members of the Municipal Council, more particularly interested in the improvement of the sewerage of Paris, have watched the experiment with interest, and I am permitted to say that the good services rendered by the combined arrangements introduced by Mr. Waring contributed largely to the influence which led the Municipal Council to decide, in its session of the 11th of April, 1884, that the preliminary official inquiry which is about to be made, and which is the prelude of a definite decision as to the method of sewerage for Paris, should relate both to the direct discharge of household wastes into existing sewers, and to their removal by separate sewers.

It seems certain that within a short time the entire suppression of vaults and movable receptacles for fœcal matter will be decreed, as well as those which receive and retain excremental matters as those which attempt a division, and are intended only to retain the solid portions; and that the immediate removal of all excremental matters and household liquids will be accomplished by their direct discharge beyond the limits of the city.

These substances will be discharged *into the sewer*, wherever the condition of the sewers is suitable; they will be sent *through the sewer*, that is to say, by special conduits located wherever possible in the interior of the large sewers, where their immediate delivery into the sewer itself would not be admissible—these special conduits to deliver *into* the sewer as soon as a point is reached where the necessary conditions for the rapid and complete removal of the discharge of such affluents is assured.

This is one of the great advantages of Waring's system of sewerage, that it can as well be established in isolated sections, constituting an auxiliary and an economical complement of the great system of sewers suited to receive fresh fœcal matter and household waste, as it can, by itself alone, be extended for the complete drainage of whole quarters or of entire cities.

Whatever may be the extension of a series of sewers according to Waring's system, it retains always, by reason of its exclusion of storm-water, the great advantage of requiring only small diameters and reasonable inclinations in which the volume of flow undergoes only slight variations, and for the cleansing of which relatively small quantities of water suffice.

The establishment and maintenance of a system of sewers according to Waring's system has therefore in all cases the advantage of being economical.

PARIS, May, 1884.

GEOLOGY AND MINING.

THE BURLINGTON GRAVEL BEDS.

PROF. JOHN D. PARKER, U. S. A.

During the summer of 1883, some students of the Kansas Agricultural College, while on a geological excursion in Southern Kansas, found on Shell Island, which is located a little below Burlington, a piece of Burlington gravel containing a trilobite. The specimen is a cast, small but quite perfect, and is evidently *in situ*, that is, it belongs to the gravel. This specimen was submitted to Prof. O. St. John, the accomplished palæontologist of the United States Survey, who identified it as belonging to the genius *Phillipsia*, of the Upper Carboniferous. This find is important, due to its bearing on the geological horizon of the Burlington gravel beds.

Prof. Schaeffer, of Cornell University, found in the gravel, a specimen of which was sent to him for examination, a large number of small silicified corals, the two genera *Fenestella* and *Tremotopora* being readily distinguishable. These genera belong to the Silurian. The late Prof. Mudge, who was probably more familiar with Kansas geology than any other person, on a casual examination of the Burlington beds in the fall of 1871, expressed the opinion that they were the result of modified drift. The beds extend over a large territory passing over the divide between the Neosho River and the Verdigris, and the gravel is found as far north as Emporia, and as far south as Oswego. I have found the gravel in walks at Topeka and Leavenworth. The Kansas River may have been the general terminus of glacial action southward in the State of Kansas, but we find boulders farther south, and possibly there might have been enough glacial action over the region of the beds to have deposited them. Or, perhaps, the drift may have been modified, and the beds transported to their present position by subsequent agencies.

Prof. O. St. John is of the opinion, however, that the beds are to be considered of local origin, and to have been derived from the Carboniferous. We give the following extract from a private letter of this eminent palæontologist, which indicates his views on the subject:

"In regard to the chert gravel from the Neosho Valley near Burlington, Kansas, it is perfectly safe to say it comes from the chert beds overlying the heavy building limestone series, well up in the Upper Coal-Measure series; the same that crowns the highland eminences south of Manhattan, and thence extending south-southwest into the so-called Flint Hills east of the Arkansas Valley, in the southern central portion of the State. It may not be strictly a "glacial" gravel, although these particular deposits might well have in part been the result

of glacial agencies; but they are to be regarded as of a local origin, as we can distinctly trace them to their native ledges only a few miles to the west or northwest of their present position in the gravel deposits, to which they might have been transported by the agency of ordinary currents. But as we do find unmistakable evidence of true erratics, or traveled boulders, as far south, at least, as the divide between the Kansas and the Neosho, it is altogether likely much of this chert gravel was transported by the same agency that brought the quartzite and the boulders from their northern home, hundreds of miles away, to their present resting place, in the superficial deposits of central Eastern Kansas. As you request, I have identified the fossils contained in the chert quartz, from which you will find they are all of Coal Measure age, and identical with forms occurring in the great chert beds, *in situ*, in the aforesaid highlands."

The Burlington Gravel Beds, in an economic view, have recently come into prominence, and will undoubtedly play an important part in furnishing Macadam for the streets of our cities. and gravel for ballasting railroads, and it is of interest to scientists to know from what geological formation these immense deposits have been derived. Such questions would be authoritatively settled by a scientific survey of the State of Kansas, during which geologists would have ample time and means for careful examinations and mature opinions.

The Legislature of Kansas cannot much longer put off the geological survey, when such vital interests are at stake as the development of the natural resources of the State. There is also a demand on the part of the most intelligent citizens of the State, that such a survey shall be made at an early day.

THE MINING OPERATIONS OF THE ROMANS.

Before the antiquarian section of the Royal Archæological Institute, which has just been holding its annual meeting at Newcastle-on-Tyne, the Rev. Joseph Hirst, of Wadhurst, read a paper on this subject. He said: As the Romans gradually extended their conquest over the world, they became more and more aware of the immense increase to their wealth that might be derived from skillfully conducted mining operations. Indeed, the desire to obtain possession of such countries as yielded most abundantly the various metals that were required for objects of use or luxury seemed to have led them to push their conquests in certain specified directions rather than in others. Spain, a country of gold and silver mines, had been called the Indies of the old world. As then Tyre and Carthage had sent Phœnician colonists to establish their factories all along the coast of Africa as far as the Atlantic, who having crossed over into Europe, settled along the far-stretching shores of Spain, and, according to an ancient tradition, pushed their trading outposts as far as the British Isles; so the Romans poured into Spain and reaped there the benefit of the discoveries and of the labors of those who had been before them in the field. Tunnelings of a Phœnician origin might still be seen in that country, and there the Romans found mines of gold, silver,

copper, tin, mercury, iron, sulphur, and salt. During the republic, the State did not occupy itself much with the management of mines, upon which it looked with some disfavor, but left them chiefly to the care of private enterprise. Very little was known about the principles that at that time guided the policy of the Romans in this matter. To one who read the thirty-third book of the Natural History of Pliny, it might appear that indifference to wealth and compassion for their fellow-creatures were at the bottom of this disfavor shown by the Romans in their early history for the work of mines. Various proofs in support of this theory were collected by Barba in his *Métallurgie*. Certain it was, that after the conquest of foreign lands, it was altogether forbidden to work mines in Italy, the mother country. Yet it was remarkable that Pliny should consider Italy the richest country in the world for mineral wealth. However much frugality, sobriety, simplicity of manners, and disregard for luxury might have been virtues practiced by the Romans in the early days of the republic, they but too often yielded in later days to sentiments of a different order. It had been submitted that the restriction limiting the number of men to be employed in the mines of Vercellæ to five thousand, so that no more should be employed in the works at one time by the public contractors, was to prevent the latter from exhausting the mines under the terms and by the force of one agreement. Similar restrictions might have been suggested for similar reasons. Thus it was forbidden by a decree of the Theodosian code to export silver from the rich mines of Sardinia on to the mainland. In course of time, however, the greed of gold, so much inveighed against by the Roman moralists, became universal throughout the empire. Mines and public works of all sorts were seized upon, monopolized, and administered by the State through the agency of public farmers, called technically *publicani*. In the days of the republic, however, only the more important mineral products, whether in Italy or the provinces, were claimed as belonging to the State. Among the works at that time in the hands of the government were, said Marquardt, the gold mines near Vercellæ, in Northern Italy, employing, as already stated, 5,000 hands; the silver mines near Nova Carthago, in Spain, where 10,000 men were employed, and where the daily output was reckoned at a value of 25,000 denarii; the gold and silver mines in Macedonia; and the tin and lead mines near Sisapon, in Bætica, the modern Almaden in Andalusia. The same fate fell to the lot of a great many other mines, which, when let out by the revenue officers to those who thus came to farm them, were deemed capable of yielding a goodly income. The greater portion, however, of the mines throughout the Roman dominion, were still left in the hands of private speculators. In fact, the heavy rent paid by private works was more profitable to the State than the smaller and more precarious sums paid by the *publicani*. Livy made the express statement concerning the iron and copper mines in Macedonia, that they were to be left in the hands of the provincials: while of the gold and silver mines, he said that, on the formation of that country into a Roman province, they were altogether closed, though it was related that some ten years afterward they were reopened and let out in the ordinary way, through the *cen-*

sores to several *publicani*. Plutarch told them that there were in his time throughout Spain and elsewhere gold and silver mines still left in the hands of private individuals which had made those who possessed them as rich as Crœsus had become by his famous silver mines. However, the mines of all kinds, which in the time of the republic were left in the hands of private enterprise, were by the more powerful emperors seized, in part to swell the public revenue, and in part to replenish the imperial private purse. Thus, as time went on, almost all the rich and large mines fell into the hands of the head of the Roman State. Among the imperial possessions must, therefore, be numbered the gold mines in Dalmatia, the silver mines in Pannonia and Dalmatia, the gold mines in Dacia, as well as the tin and lead, not to speak of the gold and silver mines, in Britain. To these might be added the iron mines in Noricum, in Pannonia, and in Gallia Lugdunensis, and the famous copper mines in Cyprus, and those of Bætica in Spain.

The reverend gentlemen here gave a minute and detailed account of all that is known as to the manner in which smelting-furnaces first came to be used and afterward developed. A curious side-light was, he said, thrown upon the whole subject of mining by the unraveling of the somewhat novel information to be gleaned from the ancient inscribed bronze tablets that were discovered in 1876 in a long since disused ancient Roman mine in Portugal. In conclusion, he said there were two distinct ways in which State mines were worked by the ancient Romans. Either they were let by the Roman revenue officers to the *publicani*, or they were kept in the possession of the State and were handed over to the *procurator*. In the first case, the *publicani* themselves undertook to pay the revenue, a fixed sum for the mines they farmed, while they themselves exacted such taxes from the owners or workers of those mines as to leave themselves a margin of profit for their trouble. In the the second case, the imperial procurators either worked the mines themselves at the risk and profit of their masters, or they let them out to companies or individuals, who paid them a certain rent fixed in proportion to the number of men employed in them. The *procurator*, if he worked the mine himself, had under him a slave, who acted as director of the work; a foreman, whose office it was to test and pass the work done; and an engineer, who had charge of the mechanical contrivances. If the *procurator* let the work of the mine out to others, it was either to a single contractor or to a company, who, before the law, had the status of *publicani*, and were often given that name. The *publicani*, however, properly so-called, were mere tax-collectors; the former, or the contractors, were real administrators of the mines. In either case, however, that is, whether the *procurator* himself worked or whether he let out the mine, he had all the accounts of the commercial enterprise to keep in an office established for the purpose. In it the *procurator* had under him a clerk or register-keeper, a steward or disburser, a collector or caster of accounts, and a treasurer. Officers and soldiers were stationed to guard the mine, and to keep order among the workmen. For this purpose, either a tribune, a centurion, or a decurio was detached from his regular corps, and stationed in the mining district, either in a position of independence, or under the command of the *procurator*. The work-

men were either common slaves, hired freemen, soldiers, or convicts and prisoners. During the age of persecution, Christians were sent in thousands to the copper mines of Palestine, and to the various mineral or stone mines of Cilicia, the Thebaid, and Cyprus; as after the taking of Jerusalem, the captive Jews were in part condemned to work in the mines and quarries of Egypt. These poor prisoners were all, like ordinary criminals on being condemned to the mines, first beaten with rods. While at work, their feet were kept in irons; they had to sleep on the bare ground, they were pinched in food, deprived of the use of the bath, and were almost naked. In the subterraneous mines each workman bore a little lamp, fixed to his forehead, to guide his footsteps and serve as a signal to others, while the air and stench of these ill-ventilated caverns were so great that the ill-treated laborers often swooned away. Pliny tells how in his day these poor creatures were kept hard at work day and night, many of them spending whole months underground without ever seeing the daylight; for the burdens they carried on their backs they handed over to others, so that the last of the file came near the mouth of the pit.

The lecturer concluded with an eloquent passage from one of the letters written by St. Cyprian, the great African bishop of the third century, in which many of these particulars were set forth. It was, he said, inscribed to Nemesianus, Felix and other seven, his fellow-bishops, likewise to his fellow-presbyters and deasons, and the rest of the brethren in the mines.—*Engineering and Mining Journal.*

ANNUAL REPORT OF THE DIRECTOR OF THE GEOLOGICAL BUREAU.

Major J. W. Powell, Director of the United States Geological Survey, has transmitted to the secretary his annual report of the operations of that bureau for the fiscal year ended June 30, 1884.

The director says that altogether the topographic field work has been materially increased. The districts in which the work has been most expended are the North Atlantic and the South Atlantic. It has been contracted in the South Pacific and great basin districts.

In the North Atlantic district the work of preparing a topographic map of New England has been initiated, and a single party has taken the field. The work in Massachusetts will be pushed with vigor.

In the South Atlantic district triangulation has been continued in the southern part of the Appalachian region, and five parties have been kept in the field. The areas arranged were comprised in the western part of Maryland, the northern and southern parts of West Virginia, southwest Virginia, western North Carolina, and eastern Tennessee, and the entire area surveyed was about 19,750 square miles. A large scale map of the District of Columbia and adjacent portions of Virginia and Maryland has been commenced. In the Rocky Mountain

district the work comprised the survey of the Elk Mountain district, a completed map of the neighborhood of Denver, and continuation of the surveys of the Yellowstone Park, and the southern plateau region.

In the great basin district a detailed map has been made of the hydrographic basin of Mono Lake for the purpose of exhibiting its remarkable glacic and volcanic features. Besides carrying forward the general survey of the Pacific region, Mr. Thompson has begun and nearly completed a detailed map of Mount Shasta. A field map covering about 24,000 square miles in northern California is now ready for the use of geologists. The survey of the quicksilver districts of California has been completed and detailed maps of several districts constructed.

In geology, Mr. Hague and his assistants have been making a systematic investigation of the physics of geyser action in the Yellowstone Park and studying other natural phenomena. Dr. Hayden has been making a series of examinations along the line of the Northern Pacific Railroad, and initial steps were taken for a study of the natural waters of Montana.

Dr. Peale has carried forward the preparation of a bibliography of the thermal springs of the United States. Prof. Chamberlin has been studying glacial phenomena, Prof. Roland Irving has been classifying the archæan rocks, and Mr. Israel Russell has continued and completed the field examinations of the basin of Mono Lake. Mr. Diller has visited Mount Shasta and the southern portion of Cascade Range in connection with the survey of that range. Mr. McGee has made a thorough geological reconnaissance from the District of Columbia as a center of the interesting zone extending from the upper Hudson to the James River. Mr. Emmons has practically completed the field work in the Silver Cliff district of his economic studies in Colorado, ane will now proceed to the study of the Gunnison region. At present his attention has been turned to problems connected with the water supply of Denver. Mr. Becker has continued his investigation of the quicksilver mines of California and has completed his field work.

While supervising the collection of palæontologic matter, Prof. Marsh has given attention chiefly to the study of the material already accumulated, and the preparation of monographic reports. His last memoir described a remarkable order of birds furnished with teeth, and one now in press describes an order of extinct mammals, the Dinocerata. A third, which approaches completion, treats of the Saurpoda, an extinct reptilian order, several species of which were of gigantic size. Dr. White has continued his studies of the invertebrate fossils of the latter geologic ages, following the Missouri River for 1,000 miles in a row-boat. Mr. Ward has undertaken the preparation of a bibliography of palæobotany. In chemic work, a laboratory has been established to meet a demand for the determination of chemic problems. The physical investigations by Dr. Carl Barns have been continued chiefly with a view to the measurement of high temperatures. He has also continued an investigation on the conditions of subsidence of very fine particles suspended in liquids, a subject of great geologic importance.

Mr. Williams' statistics on the mineral production of the United States for the year 1883 will be published, together with those of 1884, in a volume to appear in the spring of 1885.

Mr. McGee and Prof. Hitchcock have been at work upon a preliminary map of the United States, on which will be represented the present status of knowledge relating to areal geology. In this connection a thesaurus of American geologic promotions has been projected, and much work done thereon. With this thesaurus a second map, embracing New York, Pennsylvania, and New Jersey, has been projected. Much work has also been accomplished in the preparation of a bibliography of North American geology.—*National Republican.*

CORRESPONDENCE.

ARCTIC EXPLORATION.

EDITOR REVIEW :—In the August number of the KANSAS CITY REVIEW OF SCIENCE, under the title of "Arctic Corps of Explorers," I advocated a plan of Arctic exploration, which will doubtless save very much of the loss of life and money which has been entailed on the world, by a hundred expeditions, for the last eight hundred years. This plan of employing the Innuits has been in my mind a long time, but as it was, as far as I know, new to the world, I put it forth with hesitation, simply as a germ, for the consideration of practical explorers.

While attending the British Association of Science at Montreal, I fortunately met the Arctic explorer Lieut. P. H. Ray, U. S. A., at the brilliant reception given by Sir William Dawson, and learned from him that he had been using the Innuits in his work of exploration for two years, with the most satisfactory results. It will be remembered that Lieut. Ray led a polar expedition up the western coast of North America about the time that Lieut. Greely departed on his expedition, to plant colonies, on Captain Howgate's plan. Lieutenant Ray employed Innuits on his expedition, during which he never lost a man, but brought back his whole party alive, and in good condition. This very success probably led to very little being said about his expedition, which was evidently conducted on common sense principles, and showed that Lieut. Ray has the personal qualities and practical knowledge of a successful Arctic explorer.

Lieutenant Ray has very kindly sent me the following correspondence, which I take great pleasure in publishing, as he has had a wide experience in Arctic exploration, and has put the plan of employing the Innuits to a practical test:

"Chaplain Parker, U. S. A., in advocating the organization of a corps of Arc-xplorers, and in suggesting that the Inu be utilized in the work, takes a step

in the right direction, and while I may disagree with him on many of the points of detail, I fully concur with him in the main, and hope that before many years have elapsed we shall see several such corps in the field, and that the work will be vigorously pushed until many of the problems of meteorology and magnetism are solved. And this work can be done without risk to human llfe, in any latitude heretofore attained, if our people will only learn the habits and customs of the Arctic highlander, and conform to them while in that region. While I am in favor of employing the Inu in every capacity but that of observer, I am not in favor of either educating him, or bringing him down to a lower latitude for any instruction whatsoever. Take him just as he is, in his most primitive condition, with his faculties all sharpened in his struggle for existence, and he is the most useful man the explorer can have, for he can teach us in the art of wood-craft and ice-craft, and he has *inherited* that peculiar instinct of the wild hunter that no man can ever learn, after he has attained maturity.

"We can never hope to make a scientific observer of the Inu, consequently anything we should be able to teach *him*, would only tend to draw him away from his old habits, and to blunt the very faculties we are so anxious to cultivate. For it is an *art* for a man to be able to go into that inhospitable region and maintain himself with comparative comfort without fuel, and without any shelter except such as he can construct from the frozen snow, and if necessary, draw his subsistence from a region that to the inexperienced seems absolutely destitute of animal life. In the region where Franklin's party perished the Inu lives in comparative comfort, and with the death of Jens died the last hope of Greely's starving party, and Schwatka's experience shows what a man can do who will intelligently make use of these people as they are.

"During my stay in the Arctic I traveled over 700 miles by sledge through an uninhabited region. All journeys were made without tents and fuel, a small kerosene stove, that consumed only one gallon of oil every twenty days, being used to melt ice, and I never suffered from cold, and my experience teaches me that the *personnel* for a successful Arctic expedition for scientific research beyond points where a ship can penetrate should be made up in the following manner:

"First. A chief of party who has passed at least one year north of the Arctic Circle among the Inu.

"Second. The staff of scientific observers necessary to carry on the work contemplated.

"Third. One competent cook.

"Fourth. One Canadian half-breed to each sled equipped.

"Fifth. One Inu and wife to each sled, the man to hunt, guide and build snow huts; the woman to keep fur clothing and foot-gear in order.

"With such an outfit, the region to which an energetic man can penetrate is limited only by the shores of the eternally frozen sea"

P. H. RAY.

WASHINGTON, D. C., October 9, 1884.

In conclusion, I would venture to suggest, before any more costly expeditions are sent out, probably to be sacrificed amidst polar snows, that Lieutenant Ray be put at the head of a comparatively small and inexpensive polar expedition, and empowered to employ the Innuits in accordance with his plan published in this article. Let us prosecute arctic exploration *on common sense principles*, and save any further unnecessary loss of valuable lives and expenditure of such princely sums of money. The questions lying around about the polar regions are of great value to science, but they can all be solved without such a fearful loss to all enlightened nations as has been entailed for the last eight hundred years.

JOHN D. PARKER.

FORT HAYS, KANSAS, October 15, 1884.

THE COLEOPTERA OF KANSAS.—A CORRECTION.

WARREN KNAUS.

In the April number of the REVIEW, in the article on the "Distribution of the Coleoptera of Kansas" the statement is made that in the number of species and varieties, Kansas is surpassed only by Michigan with thirty-five hundred species, and by the District of Columbia with twenty-six hundred. The statement in regard to the number of Michigan coleoptera was based on the "Catalogue of the Coleoptera of Michigan" by Messrs. Hubbard and Schwarz. My attention, however, has been called by Professor Snow to the fact that the above catalogue is of the upper and lower peninsulas separately, and that consequently, many species are given twice. This I had overlooked, so that my estimate of thirty-five hundred species is almost one-half beyond the actual number in the catalogued list. Kansas therefore stands at the head of the States in the list of beetles, and is surpassed only by the little District of Columbia, whose beetle fauna has been carefully worked up by the veteran entomologist, Henry Ulke, of Washington City.

SALINA, KANSAS, September 6, 1884.

BOOK NOTICES.

REPORT OF THE COMMISSIONER OF EDUCATION FOR 1882–83: Hon. John Eaton. Octavo, pp. 1165. Government Printing Office, 1884.

The thirteenth Annual Report of the Commissioner of Education, just issued, is fully equal to its predecessors in point of interest, in the importance of subjects [di]scussed, their methodical arrangement, and wise treatment, while the informa-

tion presented is of much more recent date than that usually given in reports whose information is collected from such a vast territory and through so many instrumentalities, covering, as it does, the year closing June 30, 1883.

Little space is given in the report to a statement of the general work of the office aside from the summary of educational data which is prepared annually, as anything like a full statement of such general work would require more space than the Commissioner has at his disposal.

The contents of the appendix consist of abstracts of the official reports of the school officers of States, Territories, and cities, 314 pages, and statistical tables relating to education in the United States, 548 pages. These with the Commis-missioner's report proper (293 pages) and the index (10 pages), make up a volume of 1,165 pages.

The following circulars of information have been printed and distributed since the enumeration in the previous report:

No. 1, 1882. The inception, organization, and management of training-schools for nurses. 28 pp.

No. 2, 1882. Proceedings of the Department of Superintendence of the National Educational Association at its meeting at Washington, March 21–23, 1882. 112 pp.

No. 3, 1882. The University of Bonn. 67 pp.

No. 4, 1882. Industrial art in schools, by Charles G. Leland, of Philadelphia. 37 pp.

No. 5, 1882. Maternal schools in France. 14 pp.

No. 6, 1882. Technical instruction in France. 63 pp.

No. 1, 1883. Legal provisions respecting the examination and licensing of teachers. 46 pp.

No. 2, 1883. Co-education of the sexes in the public schools of the United States. 30 pp.

No. 3, 1883. Proceedings of the Department of Superintendence of the National Educational Association at its meeting at Washington, February 20–22, 1883. 81 pp.

The following bulletins have also been issued: Instruction in morals and civil government. 4 pp. National Pedagogic Congress of Spain. 4 pp. Natural Science in secondary schools. 9 pp. High schools for girls in Sweden. 6 pp. Comparative statistics of elementary, secondary, and superior education in sixty principal countries. Sheet. Planting trees in school grounds. 8 pp.

In addition to these publications a special report of three hundred and nineteen pages on "Industrial education in the United States" was prepared and printed in compliance with a resolution of the Senate.

The number of copies of each circular or bulletin issued has been increased to supply the correspondents of the office, and several of those most in demand have been reprinted.

As a matter of interest to our more immediate subscribers we note that,—

"The schools of Missouri seem to be in a very prosperous condition, al-

though the statistics are far from complete, as many counties failed to report fully. There were 18,239 more pupils in attendance at the public schools, which were more numerous by 137, the buildings used for school purposes by 328, and additional sittings by 11,573. Teachers numbered 1,306 more; receipts increased $257,016 and expenditures $601,046. An apparent decrease in attendance of colored youth at school is explained by the fact that thirty-two counties did not report. Eighteen fewer schools for colored youth are mentioned."

Also that,—"Very gratifying progress in school work is apparent in Kansas in 1881–82. Increases are noted in children of school age, in enrollment, in average daily attendance, in school districts organized and reporting, in districts with three months' school or more, in the average length of school term, and in the number of school-rooms. The women teaching received $1.46 more monthly pay on an average. The receipts and expenditures of public schools increased, the former by $228,458 and the latter by $197,839. An increase of $32,109 in the amount of available school fund was also reported."

The Commissioner recommends among other things:

1. That the office of superintendent of public instruction for each Territory be created, to be filled by appointment by the President, the compensation to be fixed and paid as in the case of other federal appointees for the Territories.

2. That the whole or a portion of the net proceeds arising from the sale of public lands be set aside as a special fund, the interest of said fund to be divided annually pro rata among the several States and Territories and the District of Columbia, under such provisions in regard to amount, allotment, expenditure, and supervision as Congress in its wisdom may deem fit and proper.

3. The enactment of a law requiring that all facts in regard to national aid to education and all facts in regard to education in the Territories and the District of Columbia necessary for the information of Congress be presented through this office.

4. An increase of the permanent force of the office. The experience of the office indicates clearly that the collection of educational information and publication of the same, as required by the law regulating it, cannot be properly done with the present limited clerical force.

HISTORY OF THE REPUBLICAN PARTY: By Frank A. Flower. (Illustrated.) Octavo, pp. 623. Union Publishing Co., Springfield, Ill. For sale by M. H. Dickinson.

This work is essentially historical, and, while necessarily partisan in its character, is accurate and authentic. It commences with the origin of the Republican party and traces its growth, with biographical sketches of its early leaders, from its inception down to the present day. In addition to this it is a compendium of information upon all political movements with the past quarter of a century, including the salient features of the various campaigns, accounts of Repub-

lican conventions, the administrations of the several Republican presidents, with copious tables of statistics of a valuable nature.

While intended as a work of permanent value and not merely as a campaign document, it will be found very useful to speakers and writers for the latter purposes during the campaign and as a reliable book of reference in their libraries afterwards.

LEGENDS, LYRICS AND SONNETS: By Frances L. Mace. Second edition. 12 mo., pp. 227. Cupples, Upham & Co., Boston, 1884. For sale by M. H. Dickinson. $1.25.

These poems have been very favorably received by the critics, as well as by ordinary readers, and it is not too much to say that many of the pieces give proof of a true poetic spirit, if not of real genius. No one can even glance through the book without acknowledging this, and the reader who devotes proper time to their perusal will recognize it more and more as he becomes familiar with the author's style and tone and enters into her spirit. It is certainly a book that will increase her reputation as a sincere writer and true poet wherever it is read.

THE MAN WONDERFUL IN THE HOUSE BEAUTIFUL: By Chillon B. Allen, M. D., and Mary A. Allen, M. D. 12mo., pp. 370. Fowler & Wells, New York. For sale by M. H. Dickinson. $1.50.

The authors of this book, which is a treatise on physiology and hygiene, are husband and wife, both doctors and both former teachers. They have adopted the above title and thrown the text into the allegorical form as a more attractive and *ad captandum* means of securing readers who would lay aside unread a work on the same subjects under the ordinary title.

The human body is "House Beautiful," and its inhabitant the "Man Wonderful." The building of the house is shown from foundation to roof, and then we are taken through the different rooms, and their wonders and beauties displayed to us, and all this time we are being taught—almost without knowing it—Anatomy, Physiology, and Hygiene, with practical applications and suggestions.

We are then introduced to the inhabitant of the house, "The Man Wonderful," and learn of his growth, development, and habits. We also become acquainted with the guests whom he entertains, and find that some of them are doubtful acquaintances, some bad, and some decidedly wicked, while others are very good, company. Under this form we learn of food, drink, and the effects of narcotics and stimulants.

The Table of Contents by chapters has these striking subjects: The "Foundations," which are the bones. The "Walls" are the muscles, while the skin and hair are called the "Siding and Shingles." The head is an "Observatory," in which are found a pair of "Telescopes," and radiating from it are the nerves, compared to a "Telegraph" and "Phonograph." The communications are kept

up with the "Kitchen," "Dining-Room," "Butler's Pantry," "Laundry," and "Engine." The house is heated by a "Furnace," and which is also a "Sugar Manufactory." Nor is the house without mystery, for it contains a number of "Mysterious Chambers." It is protected by a wonderful "Burglar Alarm," and watched over by various "Guardians." A pair of charming "Windows" adorn the "Façade," and a "Whispering Gallery" offers a delightful labyrinth for our wanderings.

FORESTRY OF NORTHERN RUSSIA AND LANDS BEYOND: Compiled by John Croumbie Brown, LL.D. 12mo., pp. 279. Edinburgh. Oliver & Boyd, 1884.

FORESTRY OF THE URAL MOUNTAINS: John Croumbie Brown, LL.D. 12mo., pp. 182. Edinburgh, 1884. Oliver & Boyd.

The above named volumes make up thirteen works upon forestry by this indefatigable investigator and writer upon this subject, most of which have been noticed in the REVIEW during the past four or five years. They are all designed to supply British students of forestry with valuable information obtained by the author from foreign travel.

The awarding committee of the International Exhibition of Forest Products, and other objects of interest connected with forestry, selected to award premiums on forestal literature, spoke in high terms of the works of Dr. Brown, who, being a member of the committee, could not compete for the premium. Each of Dr. Brown's works is complete in itself, though an integral part of a series of volumes in course of publication, designed to familiarize students in forestry with the applications of forest economy in different lands; and Dr. Brown's personal acquaintance with the systems pursued in most countries of the continent of Europe was found of special service to the committee.

In a prairie country like that west of us a complete knowledge of forestry must necessarily be found of the greatest advantage, and we cannot avoid recommending to the State Boards of Agriculture of Kansas, Nebraska, Colorado, etc., the purchase of a full set of these works.

A MIGRATION LEGEND OF THE CREEK INDIANS: By A. S. Gatschet. Volume I. Octavo, pp. 251. Published by D. G. Brinton, Philadelphia, 1884.

This is Volume IV of Brinton's Library of Aboriginal American Literature, and is the result of protracted and careful study of the language and ethnology of the Creek tribe and its ethnic congeners.

The story related in these pages is, as its author states, wholly legendary, in its first portion even mythical; it is of a comparatively remote age, exceedingly instructive for ethnography and for the development of religious ideas; it is full of that sort of *naïvete* which we like so much to meet in the mutual productions

of our aborigines, and affords striking instances of the debasing and brutalizing influence of the unrestricted belief in the supernatural and miraculous.

The volume is divided into two parts, the first comprising: The southern families of Indians; I—The Linguistic Groups of the Gulf States; II—The Maskoki Family; III—The Creek Indians. The second part is made up of the Kasi-hta Migration Legends, which includes Indian migration legends, Migration Legends of the Creek Tribes, Tchikillis Kasi-hta Legend, the text and the translation.

Professor Gatschet has for years made the ethnology of our Indian tribes his study, and this volume is one of the results. It evinces great labor in investigating and compiling authorities, as well as in working out his conclusions. The translation of the migration legend is by Dr. Brinton, the accomplished editor of the series above referred to.

ASTRONOMY.

SUN AND PLANETS FOR NOVEMBER, 1884.

W. DAWSON, SPICELAND, IND.

The Sun's usual motion eastward brings it to R. A. 14 hours 29 minutes November 1st, and 16 hours 29 minutes on the 30th. Its declination south on the 1st, is 14° 44′; and 21° 48′ on the last day of the month. The length of days will thus decrease during the month from 10 hours 22 minutes to 9 hours 24 minutes. Sun-spots were numerous in the early part of October; ninety-five being observed on the 2d. But only ten were visible on the 16th.

Saturn rises on the 1st of November about 6:30 P. M. Its declination is 21° 48′ N; nearly as far north of east at rising as the Sun is in longest days. So that this interesting planet is now very convenient for observation. Saturn is now retrograding—moving westward among the stars. It is just north of a small star (Zeta Tauri) and nearly half way from Aldebaran in the big A to the twin stars Castor and Pollux. Jupiter rises near 1 A. M. on the 1st, several degrees north of east; so it is still a morning star; being very bright and conspicuous, a little east of the fixed star Regulus. Although Venus is slowly waning in brightness, it is still a fair rival for Jupiter, and about two hours east of it. The phase of Venus is somewhat gibbous—a little more than half-moon shape. This planet will be near Uranus (about 1° north) in the morning of November 4. The same day Mercury is in superior conjunction with the Sun. Neptune is still about 7° southwest of the seven stars. Mars sets about 6 P. M. in the southwest, hence is of no special interest.

METEOROLOGY.

RED SKIES.

ISAAC P. NOYES.

It is doubtful if anything ever created a greater commotion in the scientific world then the red sky so conspicuous the past year. The scientists almost to a man seem to have found, for them, a reasonable solution therefor in the *dust theory*—dust either from meteors or from the volcano at Java, which occurred the latter part of August, 1883.

I, as a student of the Weather-Map, take exception to this *dust theory* and maintain that this delicate redness in the sky is the result of the presence of a minimum quantity of moisture in the air—and that water and not dust is the cause, and that it is not peculiar to times of meteoric showers or volcanic eruptions, but to those conditions which we term high-barometer, when there is the least possible moisture present in the atmosphere.

The objections to *volcanic dust* and *meteoric dust* are not altogether the same, yet they are similar and in some respects identical. First, as to *meteoric dust:* in the absence of any remarkable display of meteoric showers it could not be from near meteors; and had this phenomenon produced any such effect the dust producing it would have been so plenty all over the surface of the earth as to have left a such mark, or evidence, that it would have been useless to deny that it had occurred, and there being some possibility of this red-sky effect being produced by it. But then showers of meteors as a rule are not so universal in their distribution; they are more apt to be local; and when they do occur they are plainly seen. So this would seem to shut out near or local meteors.

It may be claimed that it came from his distant meteors within the orbit of the earth; that as the earth came around to their point the whole atmosphere would then be affected. In this case the dust would have been so far away that it would have made no difference as to time of day when, with a clear sky, it might have been seen and its effect noticed. It would not have been necessary first to have the Sun go below the horizon. At so great a distance the Sun would shine through it, equivalent to us, perpendicularly to the plane of the earth. This being the case it ought to have given, *if dust would give such an effect*, a rosy tint to the sky at all hours of the day. Again, this effect would only have been for a short time when the earth was passing the locality of these supposed meteors; and then from this distance we would either have had an abundant supply of dust to gather as evidence, or there would have been none at all to have been examined by a microscope; *i. e.* there would be no "half way doings" about it.

For these reasons, and other reasons to be mentioned, I do not believe that it could have come from meteors distant or near.

The volcano at Java, August 27, 1883, being the only *volcanic* dust claimed as having produced this effect, to that we will direct our attention. It is said that it was an immense volcano and that the world never saw such a phenomenon in this department before—it excelled all others—that the air for miles around was thick with dust and ashes; that the dust was thrown 3,000 feet! in the air. From the height at which the dust was thrown it would seem, to one not posted in modern meteorology as revealed by the Weather-Map, and as to the height that the clouds move, that 3,000 feet was a great distance. A monument 600 feet high would be extraordinary and of immense height, but what would such a height be beside a mountain six miles high? The highest clouds, it is said from good authority, move at an elevation of 23,000 feet, or over four miles, showing that the currents of winds are at least that high, and the chances are that they are even much higher. What is 3,000 feet to this? But, it may be asked what has this to do with it? If one will study the Weather-Map and note the storm-centres thereon—how they move, how they create the currents that gather the clouds, that produce the rain, he will see that these storm-centres are located over the world, from 1,000 to 2,000 miles apart, that they travel in belts and on all sorts of lines. That between the centre of the United States and Java there must be at least six of these centres on one line. We cannot, at present, for want of stations, prove how many belts there are between these points, but as near as we can ascertain there must be about three between there and here. At each one of these storm-centres the wind is blowing from all points of the compass, north, east, south and west, at the same time; and, as above stated, these storm-centres affect the movement of the clouds at least to the height of 23,000 feet, and the lighter atmosphere undoubtedly above this point. This being the case, it would be impossible for any material like dust or even a balloon, that could only attain the height of 3,000 feet, to pass over one of these centres or the atmosphere centering to them, and pass on to some remote part of the world. Before we had the Weather-Map we could not be blamed for thinking that our atmosphere followed the surface of the earth around as the water poured on a grind-stone follows the stone around, but it does not. The water on the grind-stone is no parallel.

This dust would be gathered by the first storm-centre within its locality, whether, east, west, north or south; and after it had reached the centre there would not be much dust remaining in the air to be passed on to some other point. It would be precipitated then and there. It might travel 1,000 or 2,000 miles, but would not get beyond that limit. But it is said that dust has been seen in the air and gathered, and is now held as testimony in the case. I have not the least doubt but what a *little* dust can be found in the atmosphere at any time, for the wind is always raising more or less, but this does not reach a very high elevation, at least independent of high elevations. It may be found on a high mountain, but that would be only relatively high.

The great Michigan fire in September, 1881, might be brought forward as evidence of extensive discoloration of the sky by smoke, then the query may be raised: if smoke may thus discolor the sky, why not dust?

If one will refer to the Weather-Map for that date he will see that on that day we had an area of low-barometer on a high line of latitude. The smoke effect took place in the track and within the influence of this "Low," and nowhere else; and it only lasted a few hours, in all about half a day. It did not continue on around the world, west as well as east, and continue for months.

We occasionally have a tornado. The dust raised from this source is local, but at times it spreads over a great extent of territory and fills the air with fine dust, and dust that ought to remain in the air as long as any volcanic dust from Java, and yet who ever heard of this dust for even one day producing a red sky? As to the properties of dust, it will not, even under the most favorable circumstances, compare with water in the power of refraction; as for its power of reflection it must be of very bright surface to produce much effect in this line. Water will produce such effects; the evidence thereof is daily before us; we have but to look at the clouds, at the ocean, and at the rainbow.

In meteorology we have high and low-barometer; the one may be termed the atmospheric-hill, the other the atmospheric valley. "Low" or low-barometer is the is the agent of the storm; the centre to which the winds are gathered. The clouds are being formed wherever there is heat and moisture; as the clouds are formed the winds carry them along towards "Low." On the surface of the earth this movement is from the "High" to the "Low," the result is that there is little moisture at "High," but then it is impossible to remove all the moisture from "High" *and it is just the little, the minimum, which remains that produces the delicate pink or red sky.* In the area of "High" there are few or no clouds present—the sky is clear. The moisture present is so thin that we do not see it when the sun-light is at right angles to the cloud stratum or moisture. It is not until the Sun is below the horizon, when, as it were, we see through this thin atmosphere edgewise, that the effect is produced; also in addition to this the Sun shines up underneath this delicate cloud formation and illumines the under side of it. This is well illustrated by a piece of glass; hold it so the plate or pane is perpendicular to the light and we see no color, turn it edgewise to the light and we have quite a strong green color. We also see this same general effect in the Moon, when it rises of a clear night, while at the horizon, when we see it through the lower stratum of atmosphere, through the atmosphere edgewise, it appears to be of a deep red color; when it has ascended to mid-heaven, if it is a clear night it is of a bright silver-white, yet it is the same Moon that at the horizon was a deep red. The Moon has not changed, it is only the different atmosphere through which it is seen that produces the effect. So there is no doubt as to the power or property of water to produce this phenomenon.

Those who have earnestly supported the dust theory have considered it conclusive that this red-sky phenomenon was seen in "foggy England," and yet a little further on they say that the atmosphere was the while "*remarkably free*

from moisture." A fact is of no value in an argument unless it effects the evidence. How nicely these two facts support the water rather than the dust theory. Seen in "foggy England," *but only seen when there was no fog in the air!* When it was clear atmosphere. Now they cannot have a clear atmosphere even in foggy England without the presence of high-barometer.

This redness may also be produced partly from artificial source. Let the air of an evening be quite thick with moisture; like what it is when the "Low" centre is off to a great distance; not thick enough for a fog but a slight presence of suspended moisture. Let this be over a city or where there is considereable light. The light shining on and through this mosture will produce the same general effect of redness.

The evening of June 12, 1884, in Washington we had a peculiar effect of red sky, only a part of the sky, a space of about 30° was of this delicate pink color, while the rest of the heavens was a delicate green. In the first place it is very queer if this pink or redness is caused by dust that the dust should be so peculiarly suspended in the air, and again that this dust should remain so many months thus suspended.

This peculiar line was evidently caused by the formation of the clouds below the horizon. We cannot prove this but it is the only reasonable cause, and is most reasonable.

Again on the evening of June 28, 1884, ten months from the time of the volcano at Java, we had in Washington, D. C., a most brilliant and magnificent display; the sky was clear, without a cloud; no grander display have we had than this. On all of these occasions the area of high-barometer has been over us. In addition to all this another important fact must not be overlooked. Even when it is quite cloudy, when "High" is upon or near us, this delicate pinkness will occur whenever there is a piece of clear sky, between the heavy cloud patches. This coloration is from the same cause as produces the extended coloring with a general clear sky, wherever there is clear sky, whether in patches or in mass, between clouds, or freedom of clouds, the effect is the same. When in small patches the effect is local, when in mass it is general. When this effect occurs, as to time, its strongest and best exhibition is when the Sun is some distance below the horizon; it shines up and illumines underneath the vault of the grand dome of the heavens above us. The further the Sun is down, until it has passed beyond the limit, the higher up on this vault, or underside of dome, does throw its light. This is conclusive proof in itself that it cannot be the dust from afar; from distant meteoric dust. If it was from near dust, and if dust could produce such an effect, the amount of dust that it would take to produce it would be of such a quantity as to leave its mark upon the earth, a mark that would not be overlooked or slighted.

In opposition to all these facts and impossibilities those who advocate the dust theory have only one point of importance, and that is they say that they have gathered some of the dust and that on examination the particles agree in formation with the particles from Java.

Now in any case of evidence where there were so many strong facts on one side and only one on the other would any jury in the land give a verdict against the side of many facts in favor of the one fact no stronger than any one of the facts on the other side? Would they not be apt to say, if this phenomenon is produced by dust, why not gather more of it—quantites of it—right here when the phenomenon occurs? When the phenomenon continues for month after month, and is so conspicuous and general would they not be apt to hold that this dust ought to be so thick in the air as to cause a universal discomforture therefrom; would they not be apt to require a sample of dust possessing such luminous qualities, not a mere grain or two but a *quantity?* I think they would at least demand this much if not more.

On the other hand there would be no difficulty in proving to them that this phenomenon occurs, every time, under certain conditions of the atmosphere; and only at these times. That moisture is thus suspended in the air, and that it has all the qualities to produce such an effect.

People not familiar with the Weather-Map cannot well appreciate the full force of this presence of delicate moisture. They may think it peculiar not to have it regularly, at stated times, and as much or little one year as another. But herein is one of the special beauties of this wonderful map. It shows us that nature is never twice alike. Here in the United States the year of 1883, as a whole was conspicuous for a prevailance of "High." What were the conditions over the rest of the world we cannot prove, as here, by actual observation, but if a certain condition is the cause of a certain natural phenomenon here it is safe to say that a like effect in other countries will be produced by a like cause, and more particularly so when we have all the indirect proof, sky and color, which is the natural result of this condition.

The areas of high and low-barometer travel around the world in belts. These belts vary in line and form and are never twice alike. The peculiar juxtaposition and course of "Low" and "High" is what makes the variation in our weather. A high "Low" giving us hot, dry weather with occasional local showers; "High" over us giving us cool, pleasant weather that does not require much moisture, for not much is used. In this case the moisture is not taken away, out of the ground, etc., and transported somewhere else, as with high-"Low" and southerly winds over a great extent of country. With "High" the sky is clear and quite free of clouds; there not being much moisture and heat to generate them, nor wind to bring them from afar. What moisture then is present is disseminated to such a degree that the direct rays of the Sun, at right-angles to the earth, does not reveal its presence; it is only when the Sun is below the horizon that its presence is realized.

If this phenomenon is caused by dust it would seem that we ought to have the supply of dust replenished quite often, but we have had no new supply and yet the phenomenon continues.

Unfortunately the Weather-Map is a new thing and the scientific world therefore knew little or nothing about it. Hence it is not surprising that they should

have been thus misled by this great eruption at Java, but now that the phenomenon continues it seems most absurd to hold on to so unsatisfactory an explanation, when we see the many facts that can, mostly through the Weather-Map, be brought to disprove it. This dust theory may have answered very well, like the absurd theories of the weather prophets, for years gone by but for the present, with the light of the Weather-Map it seems too absurd for intelligent persons to believe.

WASHINGTON, D. C., July, 1884.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Sept. 20th to 30th.	Oct. 1st to 10th.	Oct. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	52.	34.	49.	45.
Max	99.	89.	89.	92.
Min. and Max	75.	61.	69.	68.
Range	47.	55.	40.	47.
TRI-DAILY OBSERVATIONS.				
7 a. m.	64.1	62.6	56.9	61.2
2 p. m.	83.2	79.2	81.9	81.4
9 p. m.	67.6	63.4	62.2	64.4
Mean	71.4	68.4	67.0	69.0
RELATIVE HUMIDITY.				
7 a. m.	79.5	83.1	84.0	82.2
2 p. m.	58.8	48.9	52.8	53.8
9 p. m.	83.8	81.0	80.0	81.6
Mean	78.0	71.0	72.3	73.8
PRESSURE AS OBSERVED.				
7 a. m.	28.880	29.007	29.128	29.005
2 p. m.	28.960	28.985	29.115	29.020
9 p. m.	28.872	29.002	29.124	28.999
Mean	28.873	28.998	29.122	29.008
MILES PER HOUR OF WIND.				
7 a. m.	12.5	14.1	19.2	15.3
2 p. m.	21.2	17.9	14.6	17.9
9 p. m.	11.0	12.4	14.0	12.5
Total miles	3086	3650	2484	10220
CLOUDING BY TENTHS.				
7 a. m.	6.1	5.0	3.2	4.8
2 p. m.	5.3	3 6	2.9	3.9
9 p. m.	4.2	4.0	3.0	3.7
RAIN.				
Inches	4.36	1.58	.47	6.41

The first frost of the season occurred October 9th, a slight white frost which hardly injured vegetation at this place, and there was no recurrence of frost up to the 20th.

The last decade of September was very wet; over four inches having fallen in one rain on the 27th and 28th. The rains of October have not been excessive, but with the previous saturated condition of the soil a small amount has kept the tilled fields very moist, and potatoes have rotted in consequence.

The red sunsets have been scarcely inferior to those of last year at this time, which first attracted the attention of the scientific world. They have seemed most brilliant on those evenings which succeeded heavy rains, and this is another reason for thinking the moisture largely concerned in their production. This of course does not militate against the volcanic dust theory which furnishes the nuclei around which these water particles can condense at high elevation.

ST. LOUIS ACADEMY OF SCIENCE.

The Academy of Science held its first meeting since the summer vacation at Washington University, October 6th. Prof. Nipher read a paper on the relation between the violence and duration of maximum rains.

His data was taken from Dr. Engelmann's observations, lasting over a period of forty-seven years. The violence of the rain is measured by the amount of rain falling per hour. Taking only the heaviest and longest rains during the above period of time, each rain is represented on a diagram by a point, if the duration and violence of the rain are taken as co-ordinates. It was found that rains of great violence lasted a comparatively short time, while gentle rains of a quarter of an inch per hour may possibly last a long time—as much as twenty hours in extreme cases. When all the points representing all the rains had been plotted on the diagram, it was found that a curve passing through the outermost points, representing the rains where the greatest amount of water falls, is an equilateral hyperbola. This means that the duration of maximum rains is inversely proportional to the violence, or that the product of violence into duration is constant. This constant is the amount of water which may fall in a continuous rain, and is, for Dr. Engelmann's series of about half a century, about five inches. A rain of five inches per hour may last one hour, a rain of four inches per hour may last an hour and a quarter, and such a rain Dr. Engelmann observed. A rain of two and a half inches may last two hours, and several such rains were observed. A rain of an inch per hour may last five hours. Each of these cases would be a five-inch rain. For a longer period of time than fifty years it is likely that greater rains than five inches may be observed. The same is to be said if observations are to be taken over a wider area of country. In fact, a rain of six inches in three hours occurred near Cuba, Mo., some years since. This would increase the value of the constant from five to six, but otherwise the relation will probably remain unchanged.

The importance of this law is very great in engineering, where the capacity of sewers, culverts and bridges must be such as to carry the water. A more general investigation, which Prof. Nipher is now making, will determine the relation

between the violence, duration and frequency not only of maximum rains but of all rains.

When this work is completed it will enable an engineer to construct the water-ways of bridges of such a capacity that they will probably stand a definite number of years before they are washed away. This number of years will be so determined that the interest on the invested capital during the probable life of the bridge will equal the possible damage when the destructive flood comes which the engineer determines shall destroy his work. The running expense of maintaining the bridge is then the least possible.—*St. Louis Republican.*

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

GRAPE-CRUSHING APPARATUS.—The object of this invention is to provide a grape-crushing machine of such construction that the body of the grapes after thorough maceration will be immediately separated from the waste portions thereof, and to provide improved means whereby the latter may be expeditiously expelled from the crushing-chamber.

The invention consists of a semi-cylindrical crushing-chamber composed of a pair of semi-circular end pieces, or heads, to the circular edges of which are attached in a slightly separated position—to form a porous bottom, square-ended strips, V-shaped in cross-section.

The said chamber being provided with a suitable supporting frame, across the upper portion of which is journaled a pendent agitator having a serrated crushing head that is adapted to be oscillated within the said chamber in close contiguity to the circular bottom thereof.

A feeding hopper of sufficient capacity is placed directly over the crushing-chamber and the uncrushed fruit is supplied to the crushing devices through an opening controlled by an oscillating plate or valve that is pivoted therein across the framing of the machine.

Across the upper horizontal bars of the said framing is journaled, in suitable bearings, the shaft of the pendent agitator frame.

This latter is provided upon its outer or crushing surface with intersected grooves, or serrations, so that the skins of the grapes may be more easily ruptured thereby and the same having a radial movement corresponding to the internal diameter of the crushing-chamber, it is therefore adapted to be oscillated in very close contiguity to the circular bottom thereof.

The bottom of the said chamber is formed of narrow strips, the sides of

which are chamfered from their inner edge outwardly, only leaving a sufficient portion square at the ends for attachment to the heads of the chamber against the edge of which they are securely clamped by metal hoops.

A section of the bottom is provided with hinges and may be opened downwardly for clearing out the exhausted material. By oscillating the agitator several times by means of a hand-crank fixed upon the outer end of the agitator shaft, the clearing operation will be effectively accomplished.

The feed-opening through which the grapes pass from the hopper to the crushing-chamber, is controlled by an oscillating plate pivoted within the opening and provided with means by which it may be graduated from time to time, as required.

This invention was recently patented by Messrs. William Maerz and J. B. Klumpf, of Kansas City.

WATER-TUBE STEAM BOILER.—This invention relates to such simple improvements upon water-tube steam boilers that the same may readily be constructed at any desired location.

The boiler is especially designed for use in connection with steam heating, as all its parts excepting the castings and the drums may be cut from ordinary steam or gas pipe.

Each section of the boiler consists essentially of either a single or double row of horizontal tubes, preferably the latter, placed in a vertical line with each other and having their front ends fixed within a vertical cast-iron flask that is attached by means of threaded nipples to an intermediate drum situated transversely to the lines of tubes and directly above the said flasks, and to which each vertical flask is connected, at its upper end.

The intermediate drum is provided with a vertical threaded connection by which it is placed in communication with the main steam-drum.

The before mentioned horizontal tubes are cut to such lengths that the lower and the ones of shorter dimensions will, when provided with an elbow be of the desired length for attachment by means of a short vertical pipe or nipple to one of the threaded openings in a corresponding horizontal flask near the end opposite the neck thereof, and the succeeding upper rows progress rearwardly in length, the distance between the centers of the openings in the said horizontal flasks.

Each horizontal flask is, preferably, slightly inclined toward the mud-drum to which they are connected. The said mud-drum is connected with the lower surface of the main steam-drum by means of a single vertical tube of sufficient size.

The elbows, if so desired, may be dispensed with by bending the tube downwardly at the rear ends at a rectangle to the horizontal flasks, to which they may be directly attached by any approved means.

In operation the tubes and the main steam drum being filled with water to the centre-line of the latter, the water in the tubes when heated rises in the verti-

cal ends thereof and moves forward and upwardly through the vertical flasks and the intermediate drum to the main steam drum, thence rearwardly therein and downward to the mud-drum, at which point a considerable quantity of the impurities of the water are deposited, and may be removed, as convenient.

In setting this boiler for steam-heating purposes the walls of the furnace are constructed with an annular air space, within which project suitable deflecting-plates built in the walls for the purpose of detaining the upwardly moving heated air. This latter is admitted through openings near the floor, and controlled by registers situated above the furnace, from which point, after being heated by contact with the walls of the furnace, it is conducted to the room above the boiler, as desired.

The inventor is Mr. J. E. Lewis, of Bowdoin Centre, Maine.

A BUREAU OF SCIENTIFIC INFORMATION.

With a view towards the more general dissemination of the results of scientific investigation, and of facilitating the work of the student in natural history, the following members and officers of the Academy of Natural Sciences have associated themselves into a Bureau of Scientific Information, whose function shall be the imparting, through correspondence, of precise and definite information bearing upon the different branches of the natural sciences. It is believed that through an organization of this kind considerable assistance can be rendered to those who, by the nature of their environs, are precluded from the advantages to be derived from museums and libraries.

As the organization is of a purely voluntary character, it is to be hoped that no unnecessary burden will be imposed upon its members by communications of an essentially trivial nature. All correspondence must be accompanied by a return stamp (two cents).

Joseph Leidy, M. D., Mycetozoa; Rhizopoda; Entozoa; Vertebrate Paleontology, Professor of Anatomy, University of Pennsylvania; President Academy Natural Sciences. Edward Potts, Pond Life; Fresh-water Sponges and Bryozoa. George W. Tryon, Jr., Conchology, Conservator Conchological Collections, Academy Natural Sciences. Benjamin Sharp, M. D., Worms; Annelids; Histology, Professor Invertebrate Zoölogy, Academy Natural Sciences. G. H. Horn, M. D., North American Coleoptera, President American Entomological Society; Corresponding Secretary Academy Natural Sciences. H. C. McCook, D. D., Ants; Spiders; Insect Architecture, Vice President Academy Natural Sciences. Henry Skinner, M. D., North American Moths, Conservator of Lepidoptera, American Entomological Society. Eugene M. Aaron, Diurnal Lepidoptera, Editor of *Papilio;* Custodian Entomological Section, Academy of Natural Sciences. W. N. Lockington, Echinoderms; Fishes. Spencer Trotter, M. D., North American Ornithology. Thomas Meehan, Exotic and Cultivated Plants, Vice-President Academy Natural Sciences; State Botanist, Pennsylvania. J. H. Redfield,

Ferns and North American Phanerogamic Plants, Conservator Herbarium, Academy Natural Sciences. J. T. Rothrock, Vegetable Physiology, Professor of Botany, University of Pennsylvania. F. Lamson Scribner, Grasses, Secretary Botanical Section, Academy of Natural Sciences. H. Carvill Lewis, Mineralogy; Glacial and Stratigraphical Geology, Professor of Mineralogy, Academy of Natural Sciences; Professor of Geology, Haverford College. Angelo Heilprin, Invertebrate Paleontologo; Physiography; Dynamical Geology, Professor of Invertebrate Paleontology, Academy Natural Sciences; Curator-in-Charge Academy Natural Sciences. D. G. Brinton, M. D., Ethnology; American Linguistics and Archæology, Professor of Archæology and Ethnology, Academy Natural Sciences. Harrison Allen, M. D., Teratology, Professor of Physiology, University of Pennsylvania. J. Gibbons Hunt, M. D., Microscopical Technology, Professor of Microscopy and Histology, Woman's Medical College. E. J. Nolan, M. D., Bibliography of Natural History, Librarian and Recording Secretary Academy of Natural Sciences. Prof. Harrison Allen, Chairman; Prof. Angelo Heilprin, Secretary.

It isto be clearly understood that the scope of the organization does not embrace considerations of a purely professional character—such as mineral or chemical analyses—nor the determination of collections, except by special agreement.

Departments not represented in the above titles will be filled as early as practicable; correspondence pertaining to such should be addressed to the Secretary. In all other departments the respondents may be addressed directly, care of the Bureau of Scientific Information, Philadelphia.

EDITORIAL NOTES.

PROFESSOR G. C. BROADHEAD, of Pleasant Hill, Mo., has been designated by Major Hilder, United States Commissioner for Missouri, to examine, classify, and label all specimens of the ores, minerals and rocks of Missouri that may be sent to him for exhibition at the New Orleans Exposition.

The State of Missouri is rich in various minerals, ores, rocks, building-stones, coal, fire-clay, ochres, fossils, etc. It will never have a better opportunity for publishing this fact to the world and advertising its wonderful natural resources, than in making a full display of them at this great industrial gathering. All owners of mines, quarries and mineral lands are earnestly requested to forward, as quickly as possible, representative specimens of their various products.

Specimens are desired of each kind of ore and their associate minerals, such as *Iron Ores*—hematite, specular and limonite, spathic-iron, clay-ironstone, ochre or paint-stuff—say several specimens of each. *Lead Ores*—including galena, coerussite, pyromorphite, anglesite, or any other forms, with the associated minerals, as calcite, pyrite, baryte, quartz, etc. Also good crystals, or masses of well arranged crystals. *Zinc Ores*—including blende or black jack, smithsonite, calamine, burotite, zinc bloom, and their associated minerals, If possible, a number of nicely crystalized forms from each mine. *Copper Ores*—of the various forms. Also carbonate of lime, or calcite, quartz, barytes,

or heavy spar, gypsum, feldspar, hornblende, asbestos, Wolfram, etc., nitre, or saltpetre, fire-clay, potter's-clay, kaolin, grindstone, gritstone, slate, marbles, polishing-stone, paving-stone, fuller's earth, limestones for making lime, hydraulic cement stone, and building stones of all kinds. The harder stones, such as granites, sandstones, limestones, etc., should be in cubes of one foot, while marbles, soapstones and slates are better if cut in slabs. The cubes should have one side broken, one side bushed, one hammer-dressed, and one polished.

Specimens of coal should show the thickness of the vein. Of clays and earthy minerals at least ten pounds should be sent.

Specimens should be well wrapped in paper, with a label enclosed indicating the locality, and name of owner or forwarder. Packed in a strong box and filled in with paper to prevent shaking or rubbing, and address to Major F. F. Hilder, St. Louis, Mo.

On October 8th the Missouri River Improvement Commission, consisting of Majors Suter, McKenzie and Ernst and Messrs. G. C. Broadhead and Broatch, met in this city to inspect the river banks and determine what is needed to improve navigation and prevent serious damage to property by the washing of the current. If work can be commenced this fall and continued during the winter, while the river is low and the current comparatively weak, it will probably prove of incalculable benefit; but if postponed until spring the high water will undoubtedly, as usual, undo all that is attempted, even if it does not cut across the narrow neck behind Harlem, and do damage that millions of dollars will not repair.

The total eclipse of the Moon of October 2d, was invisible in this country, but was successfully observed throughout Europe, and proved a most interesting spectacle. The view of the eclipse in London was superb, the atmosphere being phenomenally clear. It began at 9:33 P. M. and ended at 1:16 A. M. Elaborate preparations for scientific observations were made at Greenwich, Paris and St. Petersburg, and they proved entirely successful. At the Trocadero in Paris the public was admitted free of charge and given the use of the telescopes, while the scientific aspects of the phenomenon were explained by popular lectures.

Arrangements are on foot, it appears, for a very comprehensive exhibition of American products and manufactures, to take place in London, in 1885, and the project has been placed in charge of General C. B. Norton, secretary of the recent foreign exhibition in Boston. The idea is a good one, and General Norton, from his experience in the Paris, Philadelphia and Boston exhibitions, should be a good man to prosecute it.

Mr. Jonathan Lidwell, living near Ulmon's Ridge, Mo., found the jaw tooth of a large animal some two or three weeks ago in a spring not more than one mile from the head of the valley. Lately he commenced again to dig around the spring and found six jaw teeth and some bones. The first tooth found weighs three and one-quarter pounds, is nearly twenty inches in circumference and has been nearly a foot long, including the roots. The largest tooth found weighs over five pounds. It is about twelve inches long and four and a half inches thick. The bones found last are a portion of the hip-bones. The diameter of this bone at the joint is about eight inches one way and about twenty inches the other way.

A cable message was received October 15th at Harvard College Observatory, from Dr. Krueger, Kiel, announcing the discovery of an asteroid by Palisa, at Vienna. The position given is as follows: October 14. 4033, Gr. M. T. R. A. 2h. 18m. 26.3s. Decl. + 13° 47′ 7″. Daily motion in R. A. 56s. West, in Decl. 6′ South.

Prof. F. H. Snow, of Kansas University, reports that the month of September was remarkable for its high mean temperature and its extraordinary rainfall. Its mean temperature exceeded that of every other

September in the past sixteen years except in 1881. Its rainfall was three times the average for the month, and nearly three inches greater than that of any previous September. Excepting June, 1876, which produced 12.11 inches of rain, it was the rainyest month of any name upon our seventeen years record. There were two days in this month which registered over three inches of rain, there having previously been but five such days in the entire period of our observation.

LIEUTENANT JOHN P. FINLEY, who will be remembered by our citizens on account of his tornado investigations in this region of the country, and his articles on the same subject in the REVIEW, is now stationed at Fort Myer, Virginia, where, with the aid of four assistants, he is vigorously prosecuting his scientific observations and experiments in the same direction. Lieutenant Finley has fairly earned his promotion by hard and meritorious work, which has also been otherwise recognized by his having had conferred upon him the degree of "Master of Science," by the Michigan State College; "Fellow by Courtesy," by Johns Hopkins University, and election to permanent membership in the Meteorological Society of France.

DR. A. A. HOLCOMBE, State Veterinary Surgeon of Kansas, has written a special report upon the nature, cause, prevention, and treatment of hog-cholera, which has been published by the State Board of Agriculture for distribution among the people. Copies can be obtained by addressing Hon. Wm. Sims, Secretary, at Topeka, Kansas.

THE St. Louis Academy of Science and the Missouri Historical Society have finally gained the property which has been so long in litigation and will probably at once erect a building suitable for the purposes of both bodies. The property was donated by the late James H. Lucas, a number of years ago, but the delivery was refused by his heirs on account of delay in complying with the terms of the grantor. Such a gift to the Kansas City Academy of Science from one of our wealthy citizens would not only be highly appreciated, but would meet with a prompt response from its members.

THE International Congress convened at Washington, October 1st, to confer with regard to the establishment of a standard prime meridian for the world, was organized by the election of Admiral Rogers, of the U. S. Navy, as President; Mr. W. E. Peddrick, Secretary, and Professor Jansen, of France, General Strachey, of England, and Dr. Luis Cruls, of Brazil, Scientific Secretaries. The meridian of Greenwich seemed to be favored by the majority of the nations represented, and was finally adopted. At present, England and the United States use the Greenwich meridian, Spain uses that of Madrid, Portugal that of Lisbon, France that of Paris, and Russia that of St. Petersburg.

PROFESSOR E. B. TYLOR, president of the anthropological section of the British Association, and Professor H. N. Mosely, president of the biological section, of England, who attended the session of the British Association, at Montreal, as well as our own Philadelphia meeting, accompanied by Professor G. K. Gilbert, of the United States Geological Survey, passed through the city last month on their return to England from a visit to the Zunis, Navajoes and other tribes of New Mexico. Professor Tylor expressed great satisfaction at the result of the visit. He said he had found the Zunis to have retained in a remarkable degree, the customs and religion of their ancestors, while the Navajoes had been much altered by contact with the white race. Professor Tylor and Professor Moseley are both fellows of the Royal Geographical Society.

THE first meeting of the Kansas City Academy of Science for the winter session of 1884 and 1885 will be held at the rooms of the Young Men's Christian Association, on Friday, November 7th, at 7:30 P. M. The opening address will be delivered by the President Col. R. T. Van Horn.

THE monument of Fresnel, at Broglie, France, recently inaugurated, is of very simple design—a stand of worked stone supporting the bronze bust of the philosopher. A tablet of black marble on the wall above bears the following inscription: "Augustin Fresnel, engineer of bridges and highways, inventor of the lenticular rays, was born in this house on the 10th of May, 1788. The theory of light owed to this rival of Newton the most lofty imaginings and the most useful applications."

A deposit of excellent fire-clay has recently been discovered near Santa Fe, N. M., which is said to be of fine quality and very extensive in amount.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, *besides, without additional cost, for one year.*

THE October *Magazine of American History* is a strong and notable number. Its articles are all readable, and of timely and varied interest. The opening article, Curiosities of Invention—a Chapter of American Industrial History, from the able pen of Charles Barnard of the *Century*, will be read with interest. It is illustrated with some of the best portraits ever published of Whitney, Blanchard, Howe, Lyall, McCormick, Goodyear, and Edison, and with numerous pictures of early inventions. The Nation's First Rebellion (in 1794), by H. C. Cutler, throws new light upon a singular episode in our national history. A second scholarly paper from M. V. Moore, (copied in this month's REVIEW,) Did the Romans Colonize America? completes the list of the most important contributions for the current month.

THE *Popular Science Monthly* for November presents the following table of contents: The Relations between the Mind and the Nervous System, by William A. Hammond, M. D.; German Testimony on the Classics Question, by Frederick A. Fernald; Origin of the Synthetic Philosophy, by Herbert Spencer; The Future of the Negro in the South, by J. B. Craighead; Pending Problems of Astronomy, by Prof. C. A. Young; Drowning the Torrents in Vegetation, by S. W. Powell; What is Electricity? by Prof. John Trowbridge; Chilian Volcanoes—Active and Extinct, by Dr. Karl Ochsenius; The Chemistry of Cookery, by W. Mattieu Williams; Domestic Arts in Damaraland, by Rev. C. G. Büttner; Old Customs of Lawlessness, by Herr M. Kulischer; The Oil-Supply of the World.—I; XVI.—Sketch of Prof. James Hall, (With Portrait); Editor's Table: The American Association at Philadelphia; Harrison, Comte, and Spencer; Is the Contrast Valid? Literary Notices. Popular Miscellany. Notes.

WE find the following appreciative notice of the REVIEW in the Boston *Journal of Education* for September 15, 1884: "The KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY is a strictly popular magazine, better adapted to family reading than any other scientific journal in the country. It comprises original articles by the best writers, and selections from the best periodicals of this country and Europe, upon geology, mining, archæology, medicine and hygiene, meteorology, exploration and travels, mechanic arts, history and biography, book reviews, etc."

WE have before referred to *The Dial*, published by Jansen, McClurg & Co., Chicago, as the best journal of its kind (literary review) published in the West. After nearly four years acquaintance with it we are enabled to speak in still stronger terms of its excellence. No journal of the kind in the whole country excels it as a purely literary review. Its leading feature is the presentation of the carefully formed conclusions of special students of subjects treated on books,

which, by this method of reviewing, often serve as the text of critical and instructive essays, while the opinions expressed carry with them the full responsibility of their authors' names. To this leading feature of *The Dial*, others are added, consisting of minor book reviews, notes and comments on interesting literary events, and several full departments of bibliography, which widen its scope and enlarge its usefulness as a literary guide and a record of literary progress. $1.50 per annum.

A cable message was received by the *Science Observer*, Boston, on the 25th of September, at Harvard College Observatory, from Dr. Krueger, Kiel, announcing the discovery of a planet by Palisa, at Vienna. The position given is the following: September 22.5379, Gr. M. T. R. A. 2h. 19m. 3.3s. Decl. +14° 42′ 33″. Daily motion in R. A. —24s., in Decl. —5′. Thirteenth magnitude.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VIII. DECEMBER, 1884. NO. 8.

PHILOSOPHY.

A PLEA FOR THE OCCULT.[1]

HON. R. T. VAN HORN.

Our culture is drifting to specialty—is becoming one-sided. Our science and philosophy are specialized. Science confines itself to merely physical things, ignoring ethics; while theology restricts its teaching to the future life of man. There is no unity, each following its own lines of thought. There can be no completeness by this method. It is unscientific because all we can know of physical phenomena is from the action of unseen force. Nor can we comprehend the unseen by passing the facts and laws of the physical world. Man can never reach true knowledge until he studies both by the light which this insepa-rab relation suggests. It is from this fact that the subject of this paper is ch n—the occult in nature.

And it is well before beginning a topic to know the value of words. Oc-cu. its strict etymology means to hide—hidden. Its popular use, including th -called supernatural or superstitious, is not the sense in which it will be oyed in what follows. In the newer philosophy there is no such thing as the rnatural. The ancient philosophers used it in the sense of the principle of ngs—or the unseen in nature as distinguished from the manifest. But modern

1 Read November 15, 1884, before the Kansas City Academy of Sciences.

science has rejected this conception of Aristotle, and substituted force and molecular action in its stead.

In the history of knowledge, however, we find the occult to be but a relative term. What was so in a former age is known in this, and what was occult yesterday is manifest to-day. It is in this sense we propose to deal with the word and the idea. The world had the occult in astrology, alchemy, magic, and the lightning and thunder. To-day they are knowledge, under the names of astronomy, chemistry, magnetism and electricity. The occult is now only as to the nature of these things. And this is so only, as modern thought apprehends, because thinking is fettered by fundamental conceptions as to premises, that obtained when all these were occult. The modes of thought have not been revised with the facts. Or, in other words, the basic conception of nature has not changed with the observed facts of investigation. When we go back to the time when astronomy, chemistry, magnetism and electricity were hidden from man, or obscured, we can readily grasp the theories resulting. But when we come to interpret phenomena by the light of what is now revealed we find the old systems inadequate and irreconcilable. This fact, lying at the very bottom of the discussion, accounts for the confusion of what we call the science and ethics of the time.

We are gradually changing the old form, from the occult and manifest, to a definition more in harmony with our own idioms—the seen and the unseen. Metaphysicians tell us that things as we see them are not real, only apparent or relative; that this being so, we cannot really know anything. Or, that beyond what is material and tangible is unknowable. But this is again because of the old mistake as to fundamental conceptions—or a mistake as to what is real. Our senses are for objective uses—to guard and protect the body. How then can they be the sum of knowing, or the only vehicle of knowledge. They but convey forms of knowledge to the real knower. We now recognize that the unseen governs the seen in all things. We can never attain to true wisdom by searching for the secrets of nature through matter, or for the causes of things in the physical realm. Man ought to know that it is the unseen part of himself that rules the seen. Why, then, cannot knowledge accept this fact for all as well as for self? Science calls these things the "imponderable forces." Is there any force that is ponderable? Is not, then, the unseen the real? Without the presence of the unseen everything is dead. Why then beat over the old straw of matter which when the unseen is absent is nothing?

Monotheism has been but in part developed. It reached the plane of one God, took the form of a personality distinct and apart from all else, and has so remained for thousands of years. This personality, thus dwarfed, ruled the universe and managed it as will or caprice determined. But monotheism itself now feels the impulse of the newer thought, and is unfolding as a universal principle, the conception of which is to be interpreted from universal nature. Or, in other words, the one God pervades every atom of nature as one force, one prin-

ciple, one potency—the phenomena we see being the expression of this one All. Such is to be the monotheism of the future.

Science, in the pursuit of the constitution of things physical, pursues the right method in the study of ultimates. But science as to philosophy begins at the wrong end. You can ascertain the combinations of matter by this method, but you cannot build a world by analysis, or discover the law of God by disintegration. You can take a watch apart, count and name the pieces, but the watch is gone, and the secret of the maker is his secret still—his thought has escaped you. But if you accept the maker and study it in its related parts, his idea and its uses become clear. So we cannot find the principle of things by breaking them to pieces by the blows of analysis, but we may comprehend the purpose of nature by accepting the idea of its unseen power and reading by the light of manifested phenomena. It is the synthetic not the analytic method that investigation must follow in this direction, because that was the method of world building. Analysis is valuable in giving the support of facts to synthesis, by showing that matter, from its law of affinity and repulsion, is adapted to world building and individualization, but it usurps a place for which it is not adequate when it assumes to be the only mode of demonstration—or the primary mode. It can show that all matter must have been homogeneous because it can be reduced to that condition—proving the direct process by the inverse method. And this is all that science has been able to do.

And here, in this connection, it may be pertinent to refer to a few recent discoveries which remove the last refuge of materialism and the mechanical theory of worlds—the heretofore unanswerable argument against the ultimate theory of spirit. Reference is made to elemental matter. The chemist had found certain substances that refused to yield to his forces, and these he called elements, and assigned to them ultimate qualities. Anything that did not recognize these elementary things was not true. The *New Chemistry* was printed in 1874 and contains a list of sixty-three of these substances. The revised edition of that book is just out, prepared by the same author, in which this formidable list is swept away, and in his preface the author says: "Except in a very limited sense, the so-called elementary substances are now seen to be as truly compounded as any other substances, and it is manifest that their qualities must depend upon molecular structure, or on the resulting dynamical relations, as well as on the fundamental attributes of ultimate atoms. There is, therefore, no longer any reason for limiting the statement of the great fundamental law of definite proportions to the relation of elementary substance, and clearness of exposition is gained by giving the statement the widest possible scope."

And so goes down this support of the physical school as the interpreter of cosmic law. And it brings into the foreground the singularly ignored discovery of Crookes, to which reference was made in a paper read before this Academy in 1881, as to the fourth or radiant state of matter. The only reason that seems to exist for this long neglect of a discovery by the foremost investigator of his time, is probably found in the closing sentence of his remarkable paper: That it

brings us to the borderland between the material and that beyond, for which the great student had such strong partiality.

And here I will refer to one more fact, the bearing of which will be seen on the thought involved. That is that Edison has, in the face of the negative of materialistic science, succeeded in passing a current of electricity through a vacuum. This implies, in the opinion of this remarkable genius, to whom electricity seems a native element, that there is still a more subtile medium, universal in nature, which acts as an agent for the transmission of electricity, light, heat and magnetism, and that the results of his experiment may be almost revolutionary in the finer calculations of astronomical science.

Are there any more barriers remaining to the conception of the spiritual? Science has about passed the limit of special interest in mere physics by these discoveries of yesterday. Matter, motion, heat, light, magnetism, electricity and force as studies must now give way to what is shown to control them. The day of the dreamer is dawning, and the time of the "crank" is near at hand. We may now return to our subject more direct. We have seen that astronomy, biology, chemistry and electricity have given up secrets that change the whole field of investigation and challenge the human intellect to new paths of exploration.

We cavalierly dismiss the wisdom of the ancients as too grotesque for modern consideration. But, after all, may it not be their way of accounting for things as we comprehend it rather than the conception underlying? We replace astrology with astronomy and substitute chemistry for alchemy, but are we sure they did not apprehend the cause, the principle, better than we. For it is a fact that every step forward in our researches brings us nearer to the ancient mysteries. The mineral to them was sentient, it is magnetic with us—but with both the fact remains of endowment with a quality that we can express in no better way than to call it life.

The great trouble after all is from the want of thinking. It seems as if a theory was necessarily a centenarian, and must live so long, no matter how many new births may happen. Newton for twenty years doubted his own theory of gravity, and now it has to bear many burdens which never had his authority or sanction. The same is true as to evolution—many things being credited to Darwin that he never taught. The power of thinking possessed by these great masters seems not to have survived them, and their hypotheses, instead of being modified by new facts, have been made procrustean beds to which all new discoveries have been compelled to conform. Their disciples have been too much like the man who when facts differed with his theory, said: "So much the worse for the facts."

A certain school have assumed that there is no such thing as intelligence in the order of nature—because they know nothing of it. Another school assumes to know, absolutely, all about the nature of the intelligence. And if a fact differs from either assumption the fact does not exist. Between the two truth has had a hard struggle. The one has its standard in what it thinks was said thous-

ands of years ago—the other denies and rests on that negative as the all of knowledge in that direction. Between the two the thinker is visionary or an infidel—and all that can be discussed inside the limits of toleration or sanity is a jumble of formulas about either supernatural and miraculous things, or an utter denial of them, with chance as providence and annihilation as the only certainty. Without suggestion or coloring, these are the horns of the dilemma with which the recognized teachers confront poor humanity to-day. Beside these the so-called superstitions of the ancients were very gospels to the race.

The occult in this modern age, it will be perceived, is vastly narrowed from what it was in the time from which philosophy draws its inspiration. Aristotle is claimed by modern materialism as its prophet, yet the chief part, the soul of his system is ignored. His terminology has been borrowed, but when it refers to the principle of things, or the cause of the manifest, it is mythical, superstition and pagan vagary, while the manifest, or phenomenal is exalted as the all of his wonderful teaching. Occult has lost its etymological meaning and been consigned to witchcraft, conjuring, demonology and related things. But even here the thought of these ancients is being vindicated in the light of discoveries in magnetism. Mesmer taught a century ago, yet the schools have only accepted his facts within a very few years. But, as hypnotism, this rejected truth takes its place in the ranks of accepted fact, and one more occult force becomes knowledge.

And now we find only one more door remaining closed between us and the wisdom of the ancients, but before that stands modern science insisting that it is only a blind door in the solid wall of the unknowable—impassable and impenetrable. And in its watch it is relieved by theology, which as in all the centuries of progress, interposed its little standard of infallibility as a barrier before every new door of truth. But reason and progress persisted in forcing the locks and as the doors swung back new worlds of knowledge stood revealed—the occult became the known, the hidden the revealed, the unseen the understood. And so will it be now.

There is one mistake a great many well meaning people make; that the discovery of something they did not know, or believe, would change the whole aspect of the world. They seem to forget that facts have always been. These people labor under the delusion that the world was made according to their plan, forgetting that they only from time to time find out a truth as to the nature of things. And they often stand amazed that as their little lights go out, the sun and moon and stars still shine on. But the man of progress rests serene. He hails each new truth as something in the grand economy of the universe heretofore hidden to humanity, and he fearlessly swings open this blind door in the wall and steps forward into another world of higher and grander phenomena.

Now let us try this door. We have passed the former ones of astrology, alchemy, sorcery and magic, and found the light of astronomy, chemistry, magnetism, electricity and mesmerism, or psychology. Before us is the door of superstition, but as it opens we are ushered into the world of life. And again

we find we have been mistaken: That life instead of being a thing of miracle, induced by an act of external power beyond natural law, sustained and ended by similar agency, is simply a part of the eternal order, and of necessity co-existent and continuous with the cause of all. For the first time, so far as we know, we are able to apprehend the problem from strictly scientific methods, and to comprehend its necessary conditions from the analogies and logic of precedent knowledge—because science has led us up to it step by step. And as mesmerism has been admitted to the sacred circle of accepted science we will use it as the key to unlock this door.

What is mesmerism? Phenomenally it is the domination of one mind by another, from a state induced by physical methods—passes by the hand and analogous processes—all of which are based upon the passage of a magnetic current or force from the operator to the subject. And your pardon is once more asked for reminding you that in this description we are still in the domain of accepted science. The conditions are simple: Given a person of strong magnetic organization and a person of nervous conditions, and the one controls the other, makes him responsive to his mental moods, or to act as willed to do, despite volition or will to the contrary. This is not mental force alone, for often the subject is far superior in intellectual power to the operator, and as a rule mentality or brain power is not a quality of mesmeric operators. What is the power? Scientifically, a stronger magnetic current thrown from the operator over the subject, which current or force is evolved by the will of the operator from the brain, just in kind as the currents from a battery. This so generated current is thrown upon the brain of the subject, and for the time paralyzes the will, and the brain responds to the stronger force.

What is the medium for transmittal? And here is another occult thing, for as yet science can tell you but little as to the function of the nerves. Physiology can name all the principal nerves and map out their modifications; can locate the nerve centres and trace the vast net-work going out from them, but beyond this it can do little else. Now, in view of all the facts we know, what can the nerves be but electricals—not only conductors, but like glass, exciters of electricity. Here, then, we have the means perfected to perform exactly what we see. Here, too, we have the agent for these phenomena of living organisms. The normal action of the nerves conveys the magnetic forces of life or excites the electrical currents in a degree that supplies the regular uses of the organism. Excessive or abnormal action or impulse produces more powerful currents, and so we see that people under excitement speak with greater force, act with higher power and perform tasks with more ease and facility than in an unexcited state. This arises from nervous action, an augmented generation of electric power, which carried to the grand centre of the nervous system, the brain, gives to the man extra mental and physical force. While this exists more or less in all, its manifestation in individuals is of degree. Hence all cannot mesmerize, nor can all be mesmerized.

And here science can find explanation for what has ever been a mystery—

the cause of temperament—or of what are called nervous organizations and the reverse. Also for that unaccountable thing so often seen in life, the control or domination of one person over another. If the nervous system is sensitive to magnetic influence it responds more quickly to such conditions, and we say the person has but little firmness or persistence of purpose, while on the contrary is the nervous organization less sensitive, the possessor is enabled to use the force of his will to throw over the sensitive person a power to which it must yield. Or the better to handle the subject mentally, we invent terms to express the two conditions—the one is positive or the generator, the other negative or the passive recipient. It must be remembered that while this mode of operation may be suggestion, the premises are not—for science admits the nerves, the brain, the magnetic force and the result. All these are determined to be, and the phenomena apparent. Granting these, the method must be just as described—from all analogy cannot be otherwise. So another occult force emerges from its hiding place and takes its position with the known.

With your permission this blind door will now be passed, and in deference to the occasion and this presence, the attempt will be made to deal with what you regard as pure speculation, or with that which science treats as entirely occult—immortality and the possibility of knowing the fact.

It is useless to travel over the old argument as to matter and mind. Much of the world's philosophy has been an attempt to have us know that we cannot know anything. This definition should supplant the present one of metaphysics in our standard dictionaries. Happily, however, this is passing away, and ere long we shall be permitted to recognize ourselves. We have been bound with a scientific bond to ultimate atoms, with a force that no theologic dogma ever exercised over men's minds. These atoms are the mathematical units upon which science builds the universe—persistent, indestructible, indivisible and unchangeable in weight or volume. These inexorable atoms are next made to account for changes of volume. temperature, latent energy, and the still more incomprehensible change of chemical properties. Can we conceive an atom from scientific formula? It cannot have color—for light, which gives color, is a mode of motion. It is neither hot nor cold—for heat is also a mode of motion. It has neither electric or magnetic qualities for the same reason. It cannot have weight or extension, for weight is the mere play of attractive forces, and extension is only known as resistance, which is a manifestation of force. It can only have magnitude, and in this regard it is not appreciable or comprehensible. If the atom is this paradoxical thing, what must we say of a cosmic theory that rests solely and only on this inconceivable thing? If the atom is not, the theory built upon it is a fiction.

In this reference to the atom, the argument is not original, but condensed from high scientific sources. It is not denied that it has been of service to chemical science, as a working hypothesis, but some of the most distinguished names in experimental chemistry—among them Cournot and Sir Benjamin Brodie, professor of chemistry at Oxford—have declared it a hindrance rather than a help,

and that it has proved itself inadequate to deal with the complicated system of chemical facts. At best it stands as the x in hypothetical formula, but must not be recognized as a fundamental fact.

Until this settled we may be permitted to enjoy two things: One is that we are, and the other is that one of our attributes is common sense. This quality tells us that we can only observe phenomena and reason from them. To our knowing we find matter as the medium of all expression in nature. We find it unorganized and organized, as we term the two states—or living and dead. If the ultimate of what we call living is unknowable, the fact is known, and we must deal with it as we know it. Science has helped us to the last tangible condition of organized matter in bioplasm, and traced for us the process of growth. But it has not been able to seize the union of life with it, or to know how it is vitalized. Its methods have utterly failed to produce the vital substance, or to generate anything living. As far as we know, matter is not intelligent, it does not think and it cannot know. The intelligent principle must then be higher than matter, as it uses it. The least we can do is to recognize this duality. We cannot call it chance, for there is no element of chance in order, purpose, persistence and duration. It cannot be matter in motion by virtue of its material forces alone—for this is simply in logical desperation inventing perpetual motion, a recognized physical impossibility, or as one writer has it, producing a machine to lay an egg that will hatch.

We may as well lay up our yardsticks, our scales, our blow pipes, our test tubes and microscopes, and start where only the human intellect is capable of starting from—God. After all our theories, systems and philosophies, this is the only true and universal working hypothesis. All that is needed from this premise is to start right—or speaking scientifically, to interpret nature from her facts. Then our conception of the great cause will grow in harmonious and widening knowledge. If, as the world has so largely done in the past, we start with a self-imagined God, denying all facts in nature that conflict with that ideal, we must end just where science found denial of such a God imperative. But we must not imitate its error and supplant him by another self-conceived hypothesis as to the nature of things. Here, in these assumptions, of both sides, as to the great principle in nature, has been the mistake of the ages—the cause of all the so-called atheism, infidelity and materialism of the world. We find out what man is by what he does, what he says, and by the logic of his action. We do not form an idea of the man and then ignore the lesson of his acts, reject what he says, or set aside the logic of his conduct. If we do so we simply find that we have mistaken the man. Let us learn of God by like methods—the investigation of nature, its laws, phenomena and uses—and we shall find him in harmony with all. And what is of supreme importance to us, ourselves also in harmony.

The primal entity in the universe is intelligence—we call it spirit. It is superior to matter because matter is used by it. Our methods are inadequate to compass its source, but we may learn its purpose. We simply know it is, through our own conciousness, and that it controls and acts through our own organism. And

we see that all other being is acted on in like manner, or exhibits like phenomena. And we see that the phenomena are in power, extent and character, just in degree with organic structure and intelligence. Our reason then says, as these are all of like quality, only differing in degree of manifestation, that the force property or intelligence that we know to be in us, is the same in all else—or is one. And as we know that we are of both matter and intelligence, we are dual in constitution. The one we call matter and the other spirit—not that the names signify, but they are the tools we handle to express the conception.

Now, as we see matter without manifestation of spirit, we must accept the conclusion that the one is at least equal to the other, and as matter is known to be indestructible spirit must be also, and we call this quality immortal. If spirit does take on matter, as we see from our birth and growth, it must have had being before it did so. And if it had being before it manifested through matter, it cannot cease to be when the matter is worn out or destroyed as to that use. You may say this is not proved, but so we have said about a great many things that have been proved. To deny is not to prove the reverse. It may be the very best we can do with our faculties at this stage of our progressive development. We know a great many things that men three centuries ago said were impossible to be known, and our experience ought at least to teach us to be modest about setting limits to the knowable. There can be no doubt if we had not set up our own little standards of truth as infallible, and refused to look beyond, the world might have been far in advance of what it is to day. It is fair to assume that there is nothing necessary to our full happiness, our moral or intellectual needs in this life or for the life hereafter, but what we have the capacity to know, or that is not within our ability to obtain. To deny this is to assert the incompleteness of our creation—that we have the quality of want without the equivalent of satisfying—an absurdity on its face, and an impeachment of the infinite power and adaptation we see in all else in the universe. The one condition is that we seek the knowledge aright. As all we see and sense has its method of coming to our observation, we can find how it comes if we only seek in harmony with the law of that coming.

Now, if life, or spirit—the presence of which gives life—has the power of coming in connection with matter for the uses we recognize, is there any principle of logic that can make its coming impossible for other uses and by other methods? Surely the claim that it can has as reasonable ground to stand on as the most vital of our scientific assumptions, as has been shown. If it comes to stay through the modes of conception and growth, it ought to be capable of the lesser function of coming on a visit to the imprisoned spirit. If it has command of the forces of nature, or the elements of organization to direct, control, mould and express itself through the physical body for four-score years, there is no known obstacle to its coming into relation with the conditions in which it existed so long, after leaving them. To claim that it cannot is to exalt the conditions and powers of matter above those that gave it the power to first come. Or it

makes the future life inferior in state to this, which would be a reversal of all else we know of the universe.

What is the method of coming? In the case of the mesmeric example we see that one spirit in the body acts upon another spirit in the body, through what we call magnetism. If this is the medium for communication or contact, spiritually, in one case, does not all nature tell us it must be so in all cases? In the one case we see that manifestation by this means is the result of what we call will power—or in other words, spirit impulse. If the intelligence, the will and all spirit attributes survive the body, why can it not exert this will power or employ this impulse in one state as in the other? It is having them that is the controlling fact. There are certain limitations on this power in the physical form from what we call law—there must be limitations from the same cause in the other. Everything cannot be possible in the one condition more than in the other—for the fundamental fact is individuality, and this must have, to be a personality, its limitations of invasion. And here, perhaps, will be found the one great obstacle to a clearer understanding and a wider acceptance of intercourse between the two states of life by humanity. Our wrong teaching as to nature, as to matter and phenomena, and as to our conception of God, has also been against the comprehension of the relation between the two states of life.

Now, suppose we conceive God, not as a separated personality, ruling by behest, but as the universal principle of nature, his commands being eternal rules or law? That what we see was not made by him as a mere experiment, but is Him—by expression. As he employs matter for the expression of himself—life and intelligence—how could that expression come from the higher life other than by a universal law? We cannot conceive of its coming by one law, going by another and returning by a third. We must be under the one eternal law before coming, while here and hereafter. Manifestation, then, is only a thing of condition and degree—just as it is in this life. A man is superior in this life, morally, mentally, physically, just as the body he lives in is adapted to these uses—conditions being equal. This fact is as well known as any other connected with his organism. In the life to which he goes after this there must be corresponding degrees in power and capacity, else the fundamental law of progress could not find operation. And nature is prolific in these analogies if we would but see them. An uninstructed man would never believe the butterfly was the risen caterpillar; but the entomologist knows it is. The man who never saw the face or conversed with the spirit of his dead friend may not comprehend the fact, but the man who has can answer the question: "If a man die shall he live again?" It is in both cases a mere fact of knowing.

Pardon a digression here, for a few general observations. It is not necessary to express an opinion as to the religious beliefs of men. But there is one thing common to all: There is not, never was a religion among men, but was founded on the belief of the existence of man after death, and his return to this life as the evidence of that existence. The facts are the common property of all in all ages, and better established than that Moses, Zoroaster, Confucius,

Buddha or Jesus ever lived. What these great teachers gave had this fact for their credentials. And upon this fact is based all the sanction for everything that is of value as to this life and of expectation hereafter by the millions of the race to-day. There is not one man in a million in civilization that really rejects it, and none outside that pale. The natural man is never a skeptic, for he always has the evidence, and has not the egotism to reject it.

The one great obstacle to the spread of this among educated and civilized men is this: That while his spiritual teachers dogmatically insist that it has been the fact in other times, they as oracularly assert that it is no longer so. They next assume that when it was so, it was the voice of God. That to deny this claim is sin, while to assert that it is so now is heresy. Reason, founded on knowledge in all departments of nature, tells intelligent men that one of these assertions must be untrue. Science knows there is a falsehood somewhere—and it has assumed that it is in the statement founded on tradition, because it finds so many other dogmatic claims untrue—and so it has rejected the whole.

Suppose we look at this question from the common sense historic view. Two thousand years ago, yes one thousand years ago, the fact of intercourse between the two states of life was universal among men. In what we call bible times it was recognized by prophet and philosopher alike. The only dispute was as to which was highest in authority. From the trials of power between Moses and Aaron and the magicians of Egypt, down to the appearance of the cross to Constantine, this was the question that divided men—not the existence of the fact. It was contemporaneous and universal. The monotheistic Hebrew recognized it and called it the manifestation and voice of God; the polytheistic Greek regarded it as a message from the gods. It was the same thing in both cases. This is the verdict of common sense, and if one was fact, both were facts, if one was false and a delusion, both must fall.

When religion became the state policy of emperors, kings and despots, it would not do for this voice to be uttered by anybody, and the fiction was invented that the day of "miracle" was closed, and that for all time to come man must receive instruction as to the future life from dogma, and not from the source that had given it in the past. So God was made a personal king to rule over all other kings, and man was to serve the king of kings by obedience to the temporal ruler who happened to be over him. And so the God of nature and his universal law of spiritual teaching were banished. This is not only the fact as reason apprehends it, but it is the literal fact as history records it. The agitation now is only the revival of what was once universal. And now science in the presence of facts it can no longer ignore, accepts what it calls "hypnotism," and for fear man may find that he is a spirit with immortal possibilities, it at once makes it the explanation of all the phenomena of seer, prophet and angelic visitation of the bible, the pagan oracles and the supramundane phenomena of the present. It is now somnambulism, nervous sensibility or unconcious cerebration induced by "molecular force." It don't matter that we don't know any more when this is said than we did when told that "life is the property of that which

lives"—it is scientific—there are the words, the words are things, and beyond them we don't know anything and you can't. And so we have the two teachers —the one that it was but is not, the other it is, but though we see we can never know. The newer thought meets both; it tells the dogmatist that if he is right as to the authority he rests on primarily, that authority can be found to-day as well as two and six thousand years ago. And to the scientist it says, if your facts are true, they tell that there is a higher power in man than mere molecular force, and that he is an intelligent being beyond his mere physical properties. If this view of things cannot stand, then all the claims of dogma, all the suppositions of science go for naught. The universe, physical, moral, spiritual, must be a whole, whether man has or has not the right conception in regard to it.

Once do away with these assumptions referred to, and the primitive knowledge as to life will be restored to man, nature will re-appear in all her gracious motherhood to humanity, and God be worshipped with an aspiration and beatitude to which the race has been a stranger. It will require a re-casting of creeds, but that which comes in their place will be purer, higher, grander, and satisfying to the soul of man.

It is not the purpose here to go beyond this limit, nor to dogmatize about the evidence, or doctrines and philosophy growing from this view of things. Only to present an argument from recognized facts of science and the premises of faith for the conclusion that there is nothing in either to forbid the student from investigating in this direction. To show that all barriers as to matter were being swept away by discovery and research, and that the theories held by men of science which shut out spirit from the problems of modern knowledge are rapidly disappearing before the march of demonstrated facts. Also, to point out that the facts of science itself have pushed the inquiry to the border of the unseen world; that we must question it to understand realities already in our possession, otherwise impossible of explanation. An intelligent mind can no longer maintain its position as such and ignore this inquiry—for all else has been exhausted. Science has piled hypothesis upon hypothesis to account for this and explain that, until its theories have undermined the very foundation upon which its whole structure rests. It is now rushing about blindly, denying, affirming, denouncing and embracing, but scarce a sun rises and sets but some assumption is exploded by new knowledge. Still it refuses to turn to the new light streaming in upon humanity, illuminating the minds of men with a fresh and wonderfully simple power. Theology too, thunders against the evidence of its own existence, clinging to its formulas as though the life of humanity would be buried under their crumbling walls. It seems to be terror-stricken that what it calls miracle should prove to be the law of creation, and that the light of inspiration and immortality shall, like the air, the sunlight and the seasons, be the possession of every human being by virtue of his being such.

This knowledge is open for all, and the privilege of acquiring it for himself, at first hands, is the one great boon that this movement of the age brings to humanity. Each for himself may look for it or not, as he pleases, and no one

has the right to say he shall or shall not. Nor has any power the right to compel or deter him,—the consequences are only to each and for each to bear. What has been said in this connection is to enforce, as it may, the truth that what has been in nature still is, that there is nothing in what is known to forbid or prevent the pursuit of knowledge in this direction, and that no authority has the prerogative to bar the aspiration of the soul for all the truth. We can repeat:

> "Yet these things were when no man did them know,
> And have from wisest ages hidden been,
> And latter times things more unknown shall show.
> Then why should witless man so much misween
> That nothing is but that which he has seen."

MINERALOGY.

THE IDENTIFICATION OF MINERALS.

A person's first thought on picking up some unknown mineral or rock from the roadside, the quarry, or the field, is—what is this? What is the name of this object? and, if he has no more knowledge of the mineral world than the majority of people, he will be unable to answer his query, unless the specimen should chance to be quartz, mica, or some such very common mineral.

After the student of mineralogy has advanced far enough in his studies to become somewhat familiar with the subject, he begins to ask himself, when examining some fragment of the mineral kingdom, of what is this object made? What is its composition? and lastly occurs the question, how was it made? This article concerns itself only with the first of these three questions. It is well, perhaps, to say here that, in order to acquire a knowledge of the physical peculiarities of minerals sufficient for their indentification, the student should familiarize himself, by frequent inspection, with the general appearance of all minerals that come under his observation, and especially the more common species, as quartz, feldspar, mica, hornblende, limestone. etc. It is very desirable for the amateur geologist to have a collection of his own, of typical specimens of fifty or a hundred of the more common minerals and rocks, which, by the way, cost very little. If this is not convenient, he should not fail to visit the mineralogical collection in the rooms of the Worcester Natural History Society, which contains, in addition to all the common minerals, many rare and beautiful specimens from all parts of the world. It is only by careful study of the specimens themselves, object lessons, as it were, that any substantial knowledge of them can be gained.

Minerals are identified, or determined, as mineralogists say, by first noting their physical peculiarities, and afterward ascertaining their chemical composition.

We will now consider the physical characters of minerals:

1. About the first characteristic of a mineral to engage our attention, is its color. Colors, as relating to minerals, are of two kinds, essential and non-essential. The essential color of a mineral is its color when in a pure state. The non-essential is mainly the color of the impurities contained in the mineral. The essential color is found by powdering the mineral or rubbing it on any hard surface, as unglazed porcelain. The powder thus obtained is called the streak, and although the non-essential color may vary greatly, its streak is always nearly uniform. A mineral shows its true color when powdered, for the same reason that muddy water becomes white when beaten into foam and made opaque.

The essential color or streak of limestone is white or grayish white; its non-essential colors range from red, green and yellow to blue, brown and black. Common feldspar (orthoclase) may be white, gray, flesh-red, or even green, as in Amazon stone, but its streak is uncolored.

Metallic minerals, those in which metallic elements predominate, are always opaque and generally have essential colors, while vitreous or glassy minerals, which are more or less transparent, often have non-essential colors, because we can see into them and discern the impurities. Magnetite (an ore of iron) is a metallic mineral, and its color and streak are both black.

2. Closely related to color is the property termed luster, by which is meant the quality of the light reflected by a mineral as determined by the character of its surface. The two principal kinds of luster are the metallic and vitreous. The former is the luster of all true metals, and of nearly all minerals which are chiefly composed of metallic elements. An example may be seen in galena. The vitreous luster is the luster of minerals in which the non-metallic elements preponderate, as in vitreous quartz. There are various other kinds of luster, as adamantine, the luster of the diamond; resinous, the luster of resin; pearly, like pearl, as talc, pearl spar; and silky, as satin spar. When luster is entirely wanting a mineral is said to be dull, as chalk and kaolin.

3. After the color, streak and luster have been determined, the hardness is the next property that commands attention. In minerals there are all grades of hardness, from talc, which is impressible by the finger-nail, to the diamond, the hardest of all known substances. To facilitate the determination of this characteristic a scale of hardness has been devised, as follows, beginning with the softest:

1. Talc.	6. Orthoclase.
2. Gypsum.	7. Quartz.
3. Calcite.	8. Beryl or Topaz.
4. Fluorite.	9. Corundum.
5. Apatite.	10. Diamond.

Of any two minerals that which scratches the other is the harder, and by testing an unknown mineral by those given in this scale its degree of hardness can be ascertained. For instance, if we have a specimen that scratches calcite, but is scratched by apatite, we estimate its hardness at 4, but if it should also be scratched by fluorite we would place it at 3.5. The hardness of all common

minerals, however, as nearly as we need to get it in order to identify them, can generally be determined without recourse to the scale. The hardness of common window-glass is about 6.5, and any mineral that will scratch it must be at least as hard as quartz, and any mineral that can be scratched by a knife cannot be much harder than 5.5. By the judicious use of the point of a knife and a piece of glass one can soon learn to estimate hardness well enough for practical purposes. In general, different specimens of the same mineral vary but little in hardness. There are exceptions to this rule, however, and some mineral species, as serpentine and calcite, vary greatly in this respect; the former ranging from 2.5 to 5.5, and the latter from 1 to 3.5.

4. The specific gravity or weight of minerals is one of their most constant characteristics. It is more difficult to discover, however, than hardness, and is therefore of less practical value as an aid in determining species. If the specimen is not too small, its weight can generally be estimated with sufficient accuracy for practical purposes by lifting it in the hand. Barytes or heavy spar can be readily distinguished from all minerals which it otherwise resembles by its much greater weight.

5. Most minerals occur more or less commonly in crystals, that is, in figures bounded by plane surfaces arranged regularly about a center. Minerals of the same species always crystallize in similar or allied shapes, and therefore the determination of the crystalline form is an important aid in identification. For instance, iron pyrites commonly crystallizes in cubes, thus rendering it easy to distinguish it from copper pyrites, which it somewhat resembles. Tourmaline and hornblende, when occurring in small fragments in rocks, are very similar in appearance, but the tourmaline can usually be distinguished by its long, slender, triangular crystals. In order to recognize any but the simpler forms of crystals a knowledge of crystallography, the science "which treats of the forms resulting from crystallization," is necessary, but as most minerals commonly occur uncrystallized, we are often obliged to depend upon other characteristics, and the determination of the crystalline form is seldom absolutely necessary.

6. Cleavage, or the tendency of a mineral to break along certain planes, is a property closely allied to the crystalline form, and is frequently useful in the identification of minerals. Common feldspar (orthoclase) can be distinguished from similar minerals by its peculiarity of breaking or cleaving in certain directions with a bright, even surface.

7. When a mineral does not occur, as is commonly the case, in distinct crystals, its general structure should be noted, whether it consists of an aggregate of fine grains like granular quartz, or forms a compact mass like flint or chalcedony. Notice if it is made up of a number of slender columns like some tourmaline, or of fine fibers like asbestos or satin spar. Sometimes a mineral has a lamellar structure, consisting of a succession of plates or leaves, like common mica. Again, it may be found in globular forms like marcasite, (white iron pyrites,) or in a shape resembling a bunch of grapes, termed botryoidal, like limonite or chalcedony. Minerals also occur coralloidal (coral-like) forms, as

aragonite, or dendritic (tree-like) shapes, as magnetite (magnetic iron ore). Other species occur as stalactites or stalagmites, as limestone.

There are also many other imitative shapes in which minerals are found, such as amygdaloidal, (almond-shaped,) reniform, (kidney-shaped,) capillary, (resembling a thread or hair,) reticulated, (net-like,) acicular, (resembling a needle,) etc. In short, a careful examination of the general structure and imitative shape, if any, of a mineral, will often lead to its identification without further trouble.

8. There are various other physical characters of minerals, such as magnetism, taste, odor, feel, tenacity and phosphorescence, that are often useful in their determination. For instance, magnetite can be distinguished from minerals which it otherwise resembles by its property of being attractable by a magnet, or magnetized knife-blade; native alum by its astringent taste; kaolin or clay by its peculiar odor; and the hydrous silicates,—talc, serpentine, and chlorite, by their smooth or greasy feel. When two pieces of quartz are rubbed against each other they will emit light, or are phosphorescent. This is best seen in the dark.

The determination of the physical characters of minerals is, generally speaking, sufficient for the identification of all common, and also many uncommon, species, but there are many others that need to be tested chemically before their identification is rendered certain. This treatment is also necessary when the chemical composition of a mineral is to be ascertained, or the exact proportion of metal in an ore of silver, lead, copper, etc., determined. This latter process is called assaying.

We will now speak of the chemical characters of minerals.

Treating the mineral with acid is usually the first step. Calcite or common limestone can be readily recognized by its lively effervescence when touched with hydrochloric (muriatic) acid, while in the mass, but dolomite or magnesian limestone will only effervesce when powdered. Other minerals require the use of strong or hot acid. In addition to hydrochloric, sulphuric and nitric acids are often used. By the employment of acids the degree of solubility is determined, the presence of carbonic acid detected, and various other results obtained. After treatment with acids come the blow-pipe tests. The mineral is placed upon charcoal and submitted to the action of the flame of an alcohol lamp or gas jet directed upon it by the blôw-pipe. The degree of fusibility is noticed, the color of the flame noted, and also the character of the sublimates, and the odor of the escaping gases. The mineral is heated in open and closed glass tubes, and then mixed with the fluxes, soda, borax, and salt of phosphorus. By these and other methods of treatment, and reference to a set of tables on the determination of mineral species, the exact status of the specimen in hand is finally decided.

The quantitative analysis of minerals, by which the precise proportion of each of their chemical constituents is found, requires a still more careful examination and additional treatment. A few words on the identification of rocks will not, perhaps, be out of place. To ascertain the peculiar species to which a rock belongs, it is only necessary to identify its constituent minerals, as, if we find a rock to consist of an aggregate of the minerals quartz and orthoclase promiscu-

ously intermingled, we know it to be a binary granite; if it contains hornblende in addition, it is hornblendic granite. If a rock is composed of quartz and mica, it is mica schist; if a combination of hornblende and quartz, it is hornblende schist, and if it is simply a mass of grains of quartz firmly cemented together, we call it quartzite.

Many rocks, however, are so fine grained that it is impossible to distinguish the minerals of which they are made up, with the unaided eye. In such cases recourse is had to the microscope, which generally reveals the character of the constituent minerals without further trouble, but quite often we are obliged to go still further and cut off a thin section or slice of the rock. This slice is mounted on a slide and carefully examined with the microscope, notice being taken of the reflected, transmitted and polarized light, change of color and various other peculiarities. The object is to ascertain the crystalline form, if any, of the minute particles of the minerals constituting the rock, the color, luster, and any other character possible. The science which treats of the determination of rocks by this method is termed microscopic lithology. Most specimens, however, can be identified without the aid of the microscope, so that a knowledge of this branch of the science of rocks is not indispensable to the amateur geologist.

W. H. L.

PROCEEDINGS OF SOCIETIES.

SOCIAL SCIENCE CONVENTION OF KANSAS AND WESTERN MISSOURI—SIXTH ANNUAL SESSION.

The Social Science Club of Kansas and Western Missouri commenced its sixth annual meeting at Atchison, Kansas, on the 6th of November, the President, Mrs. C. H. Cushing, presiding. Reports were made by the various officers, new members elected and other routine business attended to, after which the welcoming address was made by Mrs. J. J. Ingalls and responded to by Mrs. Geo. A. Eddy.

Able papers were read in the various departments, viz. in the department of Sanitary Science by Mrs. Eliza K. Morgan, of Leavenworth, upon the "Human Foot;" and by Miss Deborah Longshore, upon "Muscle;" in the department of Natural Science by Mrs. L. M. Ward, of Ottawa, Kansas, entitled "A plea for the study of the Natural Sciences;" in the department of Philanthropy and Reform by Mrs. Anna F. Burbank, upon "Individual Reform," and by Mrs. Mary Palmer Reese, of Kansas City, entitled "Woman—Her position what she makes it;" in the department of Education by Mrs. William Tweedale, of Topeka, upon "Education considered from a Practical Stand-point;" in the

department of Literature by Mrs. S. W. H. Gardner, upon Superstition; in the Department of Art by Mrs. S. M. Ford, of Kansas City, upon "Art from a practical stand-point;" in the department of Domestic Economy by Mrs. B. Gray, of Wyandotte, upon "How to Simplify Housekeeping;" in the department of History and Civil Government by Mrs. M. J. Kellogg, of Emporia, upon "Equal Wages for Equal Work," and in the department of Archæology by Mrs. H. M. Holden, of Kansas City, upon "The Lost Atlantis."

The Association was hospitably entertained by Mrs. J. J. Ingalls and other ladies of Atchison, and voted that the meeting had been a very gratifying success in every way.

We would gladly publish all of the above named articles in the REVIEW, but, as they would nearly fill the whole number, we must confine our selections to one or two written by ladies of our own city, which seem more legitimately to come within its scope.

"ART—FROM A PRACTICAL STANDPOINT."

MRS. S. M. FORD.

The art of ancient Egypt is something very far away from the Social Science club of Kansas and Missouri. Phidias, with all his power for evoking the glory and spendor of Grecian beauty, is remote from its aims and thoughts; it is doubtful if a disquisition on the comparative merits of Nicola Pisano and Michael Angelo would make a very lasting impession on it as a body, or that it would even grow wildly excited over the contested superiority of Missonier or Alma Tadema. But there is a phase of the art question which concerns us all most nearly, and which ought to be brought home to each one of our firesides, because those firesides are affected very sensibly by its neglect or attention. In these days of "Woman's Art Work," such a statement can excite no opposition, and one can easily imagine half a dozen yonng ladies from the immediate neighborhood of anywhere starting forward with such exclamations as "Why, yes, to be sure! You remember my tidy with the Graces painted on it!" or "My crazy quilt with 150 different stitches!" "Or my lovely model of grandpa's nose!" But how our sweet friends would open their eyes at the reply that nothing of this kind was hinted at in the previous observation; that most of their cherished productions are hideously in contradiction with all the rules of art, have nothing to do with art culture, and that in many cases their gentle originators would find better employment in riding tricicles than in sorting crewels?

For there is nothing more disheartening in the art prospects of womankind than the extent to which women devote themselves to "fancy work." One might say that the art developement of this country lies in the hands of its women, and how do they show their appreciation of their great taste? By crocheting afghans and painting impossible Venuses, apparently. The women in larger cities, who neither paint, model nor embroider, are decidedly the exception, for the

fashion of the day is for the feminine world to spend its leisure hours in the pursuit of art, though these same women seem not to have the slightest idea of making a study of what is to them only amusement.

They have, as a rule, no knowledge of the art of former centuries and epochs, almost none of that of to-day, their taste is fed and formed solely by the inartistic surroundings of American exteriors; they know nothing, or almost nothing, of drawing, perspective or coloring, are incapable of drawing the simplest object correctly from the life, and do not dream of originating either conceptions, plans, or even the worst rudimentary drawings for their work. No matter what kind of art work they do, it cannot help but be viciously executed, since it is begotten and bred up in ignorance, and it not only ruins the taste of its authors and observers, but occasions a waste of time which is frightful to contemplate, because it might have been so employed as to bring a rich return both to the individual and the world. The hours which women spend upon the fancy work called "art," are precious possibilities dropped into a gulf of oblivion, which swallows up not only the souls of the perpetrators but sometimes numberless other innocent and helpless ones dependent upon them for the consolations of an enlightenment, which to many human beings can only come from personal contact and inspiration.

I have heard of a woman who wears a whole dress of "rick-rack," and has no idea of the infamy sewed into it; of another who sends her children to a questionable kindergarten to "keep them out of mischief," while she spends hours of every week in embroidering designs copied from advertising cards, or in painting Cupids, heroes and goddesses, with muscles and members in such perplexing confusion that a Greek could only look at them and die. Many a woman ruins health and life, and perhaps deprives herself of the sweet blessings of motherhood for just such folly as this, and never wakes up to the fact that a real love of art and devotion to it would lift her into an intellectual region where each one of her follies and prejudices would assume a quite different aspect, and might draw her into the fields where the winds and breezes could blow away her frivolities and sweep into her mind a little of their own freshness.

"But what shall we do with ourselves?" says some fair devotee of art needlework, for in spite of eating cares and unskillful Bridgets, the women of to-day have more time to spend as they choose than did our grand-mothers. We answer, paint and sew, and pound brass, if need be, but do it intelligently, and with a wide-eyed independence which will put an effectual end to servile copying and ignorant imitation. There is, perhaps, no study among the many which women can pursue nowadays, which would be richer in results than that of art, rightly pursued, and none more unfortunate in its general results, as it is followed at present.

Every woman who wishes to do even the simplest painting or embroidery, should teach herself to draw with such skill as will enable her so to change and combine designs and patterns that she will not be forced to depend upon slavish copying for the idea and soul of her work. In any kind of art-work the charm

of individuality and originality is greater than all else, and in this, as in everything which helps a woman to rise above her natural dependence, is an incalculable benefit. The thousands of so-called "art-teachers" in the country, undoubtedly retard the possible art development of our corner of the world by constantly assuring their pupils: "You don't need to know anything about drawing, you can paint just as well by sort of working out the design with the brush, and then painting it in," etc., etc., as if the drawing were not the heart, the soul, the living foundation of every picture?

But aside from the drawing, there is another thing of equal importance, if not for the execution, at least for the inspiration, of any art work, from a bunch of violets to the "Death of Cæsar." And this is a knowledge of the growth and development of art in the world, a familiarity with the most beautiful things a man has executed, and some comprehension of their productive causes. There is no patient wood carver who will not gain new interest in his work by some knowledge of the quaint creations of the middle ages, the wealth of pictured wood with which Durer and Veit Stoss enriched the narrow streets and pointed gables of Nuremberg; not an enthusiastic crewel worker who will not work faster and dream fresher designs, if she knows something of the tapestries which the patient fingers of Matilda and her ladies made to bloom with the story of England's conquest, or of those more wonderful ones, for which the great Raphael himself made the designs. Even a simple baby-face is drawn better if one has in mind not only the sweet little cherubs which one sees upon the streets or in one's own home, but a miz-maze of all the divinity which Murrillo, Corregio, Francia, and a host of others have drawn from the child world. There is positively no end to the benefit of cultivation and intelligence in even the most elementary art-work, and if one could persuade Mr. Alma Tadema to compete with Mrs. Brown-Smith in making a crazy quilt, the effect of it would be felt immediately, for with that artist's knowledge of the color and form effects of the past and present, there could be no doubt as to who would bear away the prize.

"But," says some fair objector, "one can't learn all these things without going to Europe, and we cannot all afford to take a trip of such magnitude." Dear friend, the thoughtful observer of crewel roses would answer, you must do all this in order to appreciate a trip to Europe, and it can be very easily done. Books are so much cheaper than they were a few years ago, that any one who is willing to endure some deprivations in the way of dress for instance, can have a respectable art library, while the abundance of photographs of all pictures easily accessible, enables every one to become familiar with the works of the masters at small cost. Moreover one can obtain large carbon photographs at from three to six dollars a copy, which are really the most satisfactory reproductions of the old masters, because they represent all the cracks and defacements of the old canvases and give no false impression as to their preservation. Art culture is a very subtile thing. One can not get it from a few months sojourn on the continent, or by a hasty brushing up of knowledge in preparation therefor, it must be a slow growth fed by constant observation of good models, and this is why the carbon

photographs are such a boon to America. A few of them, with the addition of some good engravings and etchings hung upon the walls—not of the drawing room alone, unless one is a person of very elegant leisure and spends most of one's time there—but upon those of the sitting room, kitchen, and nursery, if need be, will be a constant source of elevation and refinement of taste. Few people realize how sensitive their own minds are to impressions, impressions too subtile to be felt or recorded at the time of receiving them. If they did they would be more careful of their own environments, and fewer Americans would rush through the British museum and the Louvre, naming the Elgin marbles and Venus of Milo "stumps," bringing home, one might add, no strong remembrance of foreign scenes, except the determination to serve wine with dinner henceforth.

But perhaps we are improving in regard to "environments." There is a great furore nowadays for artistic furnishing, a "craze" for Eastlake designs, painted tapestries, and bric-a-brac, without which the perfect mansion is believed to be very incomplete, and concerning which one sometimes feels like asking, is this all that constitutes the proper furnishing of our interiors? We hear very frequently the phrase, "O, she has such a lovely, artistic home"—a phrase which upon investigation is often found to mean a home where the ordinary accessories of curtains, hangings, ornaments and furniture generally are combined and grouped with unusual harmony, and where too frequently the frigidity of the perfection tells a sad tale of the extent to which the house is abandoned and forsaken by its owners and enjoyers, for the sake of preserving its treasures intact; for while the horrible parlor of our grandmothers is rapidly vanishing before the advance of civilization, the combination of poor servants and a desire for elegance, induces many a housekeeper to fill her whole lower floor with all the pretty things she can collect, after which, for the sake of keeping it in order, she deliberately shuts out the sun, the children, and that charm of her own occupancy which does more than anything else to render an apartment cozy and inviting, restricting her family—and especially the childish portion of it—to rooms devoid of ornament or pleasant aspect. Now is this all very wrong, but especially wrong in regard to the little ones, particularly if the owner of such a home is aware of the very decided difference which exists between prettiness and artistic beauty, between the artistic harmony of form and color which appeals only to the senses, and the high intellectual quality which appeals to and educates the loftiest part of our nature.

It is in this latter quality that a home should be artistic. Its walls should not only be softly and harmoniously frescoed and papered, but they should be covered—not ornamented only—with pictures which educate the senses by their beauty and rouse the purest sentiments by their silent and never ceasing appeals. Let the curtains, the furniture, the bric-a-brac be ever so beautiful, if the other element is lacking the individuality of the home is gone, for while an upholsterer of taste and intelligence can do all the rest for us, we can not hire any one to take the place of our own educated taste. In this country such home adornments

must consist largely of engravings, etchings and photographs, for few persons can afford to buy many paintings, and if these are not of the very highest order the reproductions are decidedly preferable. Again, in a home where there are children one should find as large a collection as possible of loose pictures and illustrated books, containing etchings and engravings, which the children must be allowed to handle as freely as they do their toys—books not intended for children, but such as a critical and cultured taste demands for its own enjoyment, for it is only by such constant, free and unwatched handling of precious materials, that the more precious child mind can get the food it needs to bring all its divinity to maturity. A child is even more moody than a grown person, and is not always in a receptive humor, when the mother is ready to take out the prized volumes and rare portfolios, and with many injunctions to "be careful" lay them before the childish eyes. All the intellectual doors a mother can open for her little ones must stand wide, and she must educate in herself a divine economy which will teach her that all the wear and tear of earthly fuel are nothing in comparison with the priceless fires to be fed by it, and that the little finger-marks in her valued books and pictures are the sure testimonials of unquenchable bright spots in the childish soul.

"But what is the use of all this fuss and feathers about a few pictures," cried one practical soul. "I shan't take all that trouble when I don't intend to be an artist, and what good will it do me to know a little something about the Sistine Madonna and the Laocoon?" But, dear friend, man is such a complex creature, and usually so stubborn in wickedness, that all the aids which can help him to rise above his natural animal level are worth trying. Plato rated art only fifth in the scale of good things which may elevate mankind, but we moderns, believing that art comes nearer than anything else to a visible illustration of those very unattainable ideals of which Plato is always preaching, place it among the very first of our aids to morality, because , if rightly studied and appreciated, it refines the tastes and makes the man less capable of coarse sinning, while used as a means of education, it keeps before the eyes and fastens in the mind the highest illustrations of purity, goodness and beauty.

As an educator for the body alone, art is worth introducing into every family, for there is no doubt that as a nation, Americans are sadly lacking in strength and grace of body, and there is not a household of young, growing children in the East or West, which would not profit, physically, by the daily observation of such figures as the Venus of Milo, the young Apollo with the lizard, or the Meleager of the Vatican, while the Venus di Medici would be a vivid object lesson to many a young girl who is dwarfing and deforming the figure which Mother Nature gave her by the wearing an article of dress which is worse than an eating cancer, because, as usually worn, it is eating the life and vitality out of half of the women in the land. A walk down Main Street in Kansas City is a painful experience to any one possessing a general idea of the internal structure of womanhood, together with even a moderate admiration for the soft flowing outlines of a well developed womanly form, for such a procession of coffin-shaped incapa-

bles as takes up its line of march there, would have driven Praxiteles mad! The expression, "coffin-shaped," is used advisedly, for the regulation womanly outline, which the fashionable dressmaker manufactures, refusing to fit a woman who will not allow herself to be so metamorphosed, is more like that of a coffin than anything and is as far removed as a coffin from all the bloom and beauty of nature. It is useless to talk to a woman who possesses this form, about her health, for in nine cases out of ten a fashionable woman prefers appearances to health. But convince her that she is not beautiful in this guise, so educate her taste that she recognizes the absurdity of her figure and apparel, and the battle of health and maternity would be won without a struggle. This is one of the things which art culture can do for America, and it is a thing so imperative that it would be worth the while of every father who possesses a family of blooming daughters, to invest a good share of his patrimony immediately in "casts"—cast of the beautiful old Greek sculpture which would teach his daughters how much nobler it is to stand before the world as large brained and perfectly developed women, than to cramp heart and soul to an ideal which can never go beyond the dressmaker's art.

ARCHÆOLOGY.

THE LOST ATLANTIS.[1]

MRS. H. M. HOLDEN.

If civilization be an inheritance, from what parent nation came the ancient skilled races whose handiwork and high civilization are traced with unmistakable identity from the Mediterranean nations of the Eastern Hemisphere to Mexico, Central America, Peru, and the mounds of the Mississippi Valley of the Western Hemisphere?

In the marked similarity of their traditions, religious beliefs, arts, customs implements, and weapons—is not some common source, some original home indicated?

Many inquiries are being pressed concerning the earliest people of the western world. A recent writer introduces his article with this question: "From what far off land came the primal pioneer to the shores of America?" And another: "Who were the earliest inhabitants of America?" Our savage red man no longer furnishes an answer to these questions. He is but the degraded relic of a noble ancestry whose arts and high civilization are traced back to the same period as that of the earliest civilization in the Old World. From a strict archæological standpoint the terms Old and New World are inapplicable as referring to the Eastern and Western Hemispheres. All historical students have

1. Read at the Social Science Convention of Kansas and Western Missouri, Nov. 7, 1884

grown away from the idea that Columbus discovered a new world or continent. He but re-discovered an old one.

A writer in the *North American Review* finely expressed it: "The hands of the geological clock pointed to the same hour on both sides of the Atlantic." And that "the story of early man in America is but a part of the same and greater story of his first appearance on the earth."

Retrograde periods in the progress of races being conceded historical facts, we now ask the cause of the retrograde condition of the red man at the dawn of our history, and submit to the following answer, to-wit: They had lost all intercourse with their "parent land—their "first world"—"the drowned island"—"the lost Atlantis"—by the deluge as recorded in sacred and profane history. When the island sank into the sea the path of commerce was closed for "a lapse of 6,000 years." That this island did exist and was the cradle of civilization at a remote period, and was swallowed up in a great convulsion of nature, may yet, to many, seem legendary instead of authentic history, but, says an able writer: "There is an unbelief, which grows out of ignorance as well as a skepticism which is born of intelligence." Herodotus, it is said, was called "the father of liars" for his accounts of the wonders of the ancient civilization of the Nile and of Chaldæa. For a thousand years the stories of the buried cities, Pompeii and Herculaneum, were regarded as myths, but are now accepted facts in history, and cannot we, in turn, accept the testimony of eminent scholars whose lives are devoted to research, and to whom we are indebted for the historical knowledge we already possess? Even as Herodotus incurred the derision of his time, and in later times was held in high esteem by Schlegel, Buckle and their peers, so Plato's story of Atlantis, long considered fabulous, is now being interpreted as authentic history. And, says Ignatius Donnelly, "if confirmed by farther investigation, it will prove to be one of the most valuable records which have come down to us from antiquity."

In this new era for legends, does it seem otherwise than conclusive that in in an age before there were written records, marvelous events and heroic deeds should be handed down from sire to son, and, as years rolled on, be regarded as myths and "folk-tales"? An illustration of this view occurs in the dialogue between Critias and Socrates, in Plato's History of Atlantis. Says Critias: "Then listen, Socrates, to a strange tale, which is, however, certainly true, as Solon, who was the wisest of the seven sages, declared. He was a relative and great friend of my great grandfather, Dropidas, and Dropidas told Critias, my grandfather, who remembered and told us, that there were of old great and marvelous actions which have passed into oblivion through time and the destruction of the human race." In another place Critias says: "I will tell an old world story, which I heard from an old man, who was ninety years of age." Thus, it seems that the origin of legends might be traced back to a narrative of actual events.

The verification of Plato's legend is based on both ancient and modern evidence. From the striking identity in the traditions of the ancient nations on both sides of the Atlantic—each having a flood legend concerning a "lost island

n the sea," and this location of the island corresponding so accurately in each nstance, modern scholars readily conclude that the Azores Islands in the Atlantic Ocean, west off the Straits of Gibraltar, are the mountain summits of the engulfed sland. Their conclusions are based on the investigations made by different nations. In 1873, deep sea soundings were made by her majesty's ship "Challenger." In 1874, by the German frigate "Gazelle," and in 1877 by Commander Gorringe of the United States sloop "Gettysburg." Each investigation bears corroborative proof of the other. As stated, they mapped out the bottom of the Atlantic, discovering a great elevation of land in the exact location of Atlantis, as described in ancient legends. This elevation rises about 9,000 feet above the depths around it. And a writer in the *Scientific American* of July 28, 1877, says: "This elevation must have been once dry land, as its mountains and valleys could never have been produced in accordance with any laws for the deposition of sediment, nor by a submarine elevation, but on the contrary must have been produced by agencies acting above water level." The sea soundings further revealed that there were ridges of land connecting the island of Atlantis with Europe, Africa, North and South America. These ridges, says an English geologist, were but the skeleton of an ancient continent that once occupied the space of our Atlantic Oce n, and the island Atlantis was a remnant of this buried continent. These ridges, forming land communications between the two hemispheres explain the identity in the animals and plants. From able accounts, it has been proved that the horse originated in America; and in his wild state could never have been found in Europe and Asia but for these pathway ridges of land. We also read that the fossil remains of the camel are found in India, Africa, South America and in Kansas, and that the remains of the cave lion of Europe have been discovered in Natchez, Miss. Hence, the fact of the same species being found on both sides of the Atlantic indicates that they roamed from a common center. There are numerous other instances of absolute identity, but the limits of this paper forbid their mention.

The same similarity exists in the floral and vegetable kingdom. Otto Kuntz, a distinguished German botanist, says that the banana was found in America before the arrival of Columbus, and that before a plant becomes seedless it must have been under cultivation for a long period of years. He mentions other plants that could only have been transported by bulbs and cuttings, and that by the hand of civilized man—which again supports the theory that the colonies from Atlantis carried them to the east and to the west.

The race identity of the two hemisphere bears even stronger evidence of a common and an original home than the testimony of the flora and fauna. A writer in the *Magazine of American History* says the American Indian uses the same terms in his river names that were used by all of the aggressive races that over-ran and colonized Europe, Asia and Africa. Also, "the Indian names of our rivers belong to a period when one common language was known—when one dominant race ruled throughout the entire length and breadth of America." By analysis, the geographical nomenclature of the two hemispheres can be readily

traced by its roots or germs from one nation to another. From an extensive list we give a few instances: Genesee of New York, and Yenisei of Siberia, have the same origin. Saratonka of Russia corresponds with our Indian name Saratoga. Kyogia in Africa, with Cayuga in New York. The Indian name moose is moosa in Europe and Asia. Thus, continues the aforementioned writer, "we may be able to trace the Indian back through all of the historical eras represented by the Hebrew, Sanscrit, Celtic, Phœnician, Arabic, Persian, Indo-Germanic and even through the Greek into the bosom of the Roman." And, we will add, still farther, into the heart of Atlantis.

Modern culture, for many generations, paid generous tribute to Greece and Rome as the fountains of learning, but of late years the antiquity of Egyptian culture and magnificence is engrossing the interest of students of ancient history. Says one of these, "If ever full justice is done to the achievements of a vanished race, Greece and Rome will look small as compared with Egypt." "The people who made her what she was, and what she can never be again, have disappeared forever."

Modern Egypt bears not the faintest resemblance to ancient Egypt, before she was stamped out by the Persian, Arab, Roman and Turkish conquerers.

She was in the zenith of her learning and splendor, when all Europe was a savage wilderness. She possessed a highly organized social system when the rude savages that roamed over the sites where now are situated London, Paris and Berlin were engaged in fetich worship. And, at a much earlier period Grecian scholars went and sat at the feet of Egyptian masters. Woman's status, says eminent authority, was as high in the earliest days of Egypt as now in Europe and in our own country.

Historians give us no beginning or infancy for Egypt. She appears on the horizon of history in matchless maturity. Before the time of her first king, Menes, whose reign according to Lepsius, was 3,892 years B. C., Egypt was a "highly organized and governed community." Winchell says "her people had long been architects, sculptors, painters, mythologists and theologians before the era of Menes." We now ask, from what fountain greater than herself drew she this marvelous greatness? And as we progress, we continue to step backwards and answer, Atlantis.

That under the waters of the Atlantic Ocean lies the "parent nation" of grand old Egypt seems incontrovertible as we read the testimony of late researches on this subject. So, also, do ancient Mexico, Peru, Central America, and the mound-builders of the Mississippi Valley look back to buried Atlantis for the graves of their an cestors.

How can the extraordinary similarity of these prehistoric American nations to ancient Egypt, separated by so vast a distance of land and sea, be accounted for if they did not migrate from a common home? For we read that "the pyramids of Egypt are duplicated in Mexico, Central America, and Peru. As, also, are the temples, palaces, public works, agriculture, sculpture, painting, language and religion. And that Peru had invented suspension bridges thousands of years

before they were introduced into Europe." Humboldt pronounced the Peruvian roads among the most useful and stupendous ever executed by man. Her vast wealth and high civilization, in addition to the race and tongue similarities, give her rank with ancient Egypt as a sister colony from Atlantis. The mound-builders are identified with the bronze age in Europe, which age has furnished perplexing problems for European scientists. A bronze age implies a pre-existent age of copper and tin before the art of combining them was known, but the relics of such a period have not been found in Europe. Sir John Lubbock says in his "Pre-historic Times" that the absence of implements made either of copper or tin seems to indicate that the art of making bronze was introduced into, not invented, in Europe. The ancient Mexicans knew the art of making true bronze. Their identity with the Mound-Builders is easily established, and both are traced by their language and legends to Atlantis—hence what people but the Atlanteans, whose ships, docks, canals and commerce provoked the astonishment of all who felt the aggressions of their powerful and populous island, supplied all Europe with bronze in the bronze age!

Ignatius Donnelly says that "In 6,000 years the world made no advancement on the civilization it received from Atlantis—that modern civilization is Atlantean, and the inventive faculty of the present age is but taking up the thread of original thought where Atlantis dropped it thousands of years ago." We stand with abated breath at the startling assertions, but the evidence gleaned in their favor must be withheld, as we find, at the expiration of our time, that we are but on the threshold of our subject, and to tempt you to press on and into the subject, we give you a few hints of the feast that awaits you.

"That all of the ancient civilized nations of both hemispheres were colonies from Atlantis,"—"the land of the master race."

"That the gods and goddesses of the ancient Greeks, the Phœnicians, Hindos and Scandinavians were the kings, queens, and heroes of Atlantis."

"That Atlantis was the original seat of the Aryan or Indo-European family of nations, as well as the Semitic and possibly the Turanians."

"That Greek mythology is a confused recollection of real historical events."

"That the Phœnician alphabet, the parent of all alphabets, was derived from the Atlantean alphabet" and the Maya language spoken by the ancient people of Yucatan is the survival of the Atlantean alphabet.

A writer in the *Scientific American* says the last words of our Savior were in pure Maya tongue. "Eloi, Eloi, lami sabacthani" in that tongue is,—Now, now I sink; darkness comes over me." The bystanders, not understanding his language, thought he was calling on the Father in his hour of trial.

To resume: Genesis is said to contain a history of Atlantis, and that the sinking of this island was the scene of the Biblical deluge. That there was no gulf stream previous to this catastrophe.

"That this great event was the terminus of the glacial period, the barricade being removed, the "land locked ocean" of the north met the heated tropical waters, and produced climatic changes in Europe, and but for the mild waters of

the gulf stream flowing around the submarine elevation of the buried island, it is said the British Islands would scarcely be habitable.

Thus the authentication of Plato's story opens up a wide field for new thoughts in the scientific realm as well as that of secular and sacred history, and we may grow into the belief that as once "All roads led to Rome," now all lines lead to Atlantis!!

BURIED CITIES.

All that tread
The globe are but a handful to the tribes
That slumber in its bosom.

So wrote the pensive Bryant, and every year since has but emphasized the saying. Of the numbers of the human race in past ages we can form but little idea, even from estimates, and it is almost equally difficult to conjecture the number, size and importance of the buried cities which exist in every part of the earth. Even in this country, where everything seems so new and fresh, cities are built upon the ruins of their predecessors, these having been buried so long as to leave not the least indication by which their inhabitants can be identified, and we are, therefore, left in utter ignorance who they were, whence they came and what became of them. In this part of the continent their cemeteries remain so extensive as to indicate a vast population, and in the valley of the Ohio and its tributaries their fortifications of comprehensive plan and vast extent are still to be seen, but that is all. In Mexico buried cities are found in such numbers as to give a most exalted idea of the wealth, numbers and character of population that could crowd into the country; while in Central America and Yucatan, it has been said that buried cities are more numerous than living inhabitants. This is probably an exaggeration, but the explorer may well be excused for a liveliness of imagination when he finds it almost impossible to penetrate the jungle a mile in any direction without coming upon the ruins of a little fortified town, a palace or a temple. In Peru and along the west coast of South America, buried cities are far in the majority over the cities of the present day. The difference between these buried cities of the American Continent and those of the Old World is found in the fact that the latter have a history while the former have none. If we could trace the history of the cities of our own continent back to the date of their founding, and recall the names of the now unknown heroes whose exploits made themselves and their cities alike famous, we would naturally feel a pride in the ruins of America such as is now felt by an intelligent Greek in the ruins of his own country. But this is not only at present impossible, but there is little likelihood of its ever being done in the future. The American races were not remarkable for their records, and we have, therefore, small prospect of the recovery of much, if any more of the annals of ages which preceded our own.

The ancient cities of Egypt are, for the most part, buried literally as well as figuratively, as the annual overflow of the Nile brings down from one to eight inches of sediment, and this is deposited over the entire valley. When the cities were inhabited, the floods were kept from them by means of dikes, but after war and pestilence had depopulated the entire country, the river every year swept over palace and temple and tomb, and now the cities of the Pharaohs must often be looked for under twenty feet of soil. The present city of Alexandria, for instance, is builded on the ruins of the city of the same name, founded by Alexander. This was, in its day, second only to Rome, had over 4,000 palaces and innumerable schools, colleges and art collections. It was the commercial center of the world, standing midway between the east and the west. In ancient as in modern times, it commanded the Suez Canal. This is no new enterprise of our own times. It is recorded that a canal was cut between the Red Sea and the Nile by Rameses II., B. C. 1344, though some historical records place the date a century earlier in the time of Joseph. Herodotus tells of the enlargement of this canal 800 years later; the Emperor Trajan, still later, again restored it, and it was kept open till destroyed by the Arab caliphs. A few miles south of Alexandria is Cairo, and a little south of Cairo are to be found the ruins of Heliopolis, a city known in Scripture as On. Here was once the great Temple of the Sun, where the Phœnix was consumed; here Moses was educated and many centuries later Plato and other distinguished Greeks. Of this vast city, but one stone, an obelisk seventy feet high and six feet square at the base, remains standing. The rest is beneath the alluvium brought down by the Nile. Near the old obelisk is the "Fountain of the Sun," the only living spring in Egypt, which furnished the temple with water 4,000 years ago. Not far from Helipolis are the Pyramids, of which seventy are still standing in the Nile Valley. The base of largest of these covers considerably more ground than four St. Louis squares, and the pyramid is more than three times as high as the court house dome. The latest theory in regard the great Pyramid is that it was built by order of Joseph during the seven years' famine to find employment for the people; that he was buried in it, and that the huge empty sarcophagus found in its innermost chamber once contained his body, which was removed by the Hebrews when they left the country.

A little south of the pyramids is Memphis, the Noph of Scripture, founded by the first king who ever ruled over Egypt, and for a thousand years the capital. Here Joseph ruled and Pharaoh dwelt, and here all the magnificence of the old monarchy was displayed. The embankments which once protected the city against the river have long since been swept away, and the alluvial deposits of twenty centuries have covered from sight almost every relic of past grandeur. When the English army takes its course up the Nile next month the soldiers will see a few blocks of granite, one or two mounds of sun-dried brick and the fragments of a colossal statue of Rameses II., lying with the face in a pool of water, as if ashamed of the present condition of the country. This statue was almost entitled to be considered one of the wonders of the world. It was over fifty feet

high, cut from a single block, and computed to weigh over seventy-five tons. Back of the spot where once Memphis stood lies the largest and oldest cemetery in the world. It is over twenty miles long, from six to eighteen miles in breadth, and is estimated to contain the remains of not less than 25,000,000 people. A recent writer says that it is impossible to go 100 feet without seeing skulls or other bones, while the limbs of mummies here and there protrude from the ground. In the limestone rock that underlies the desert everywhere there are innumerable pits, evidently for the burial of the middle and lower classes, and in these the bodies are stacked up like cordword, six or eight courses deep, all carefully embalmed, and looking as fresh as if placed there yesterday. The most revolting thing about the present condition of the cemetery is the fact that the natives of the country may be seen any day using the bodies of their ancestors for fuel and then employing the ashes to fertilize their fields. In this cemetery are also the burial places and sarcophagi of the sacred bulls of the Egyptians. Hundreds of these sarcophagi have been unearthed, each sufficient in size to contain the body of a large bull, and each hewn from a single block of granite. The temple which once stood over the vaults containing the mummies of the bulls was for ages buried under seventy feet of sand, but has recently been unearthed sufficiently to show its great extent and what must have been an unexampled splendor. The secret of the remarkable care in preserving the bodies of both man and beasts is found in the fact that the Egyptians regarded this life as transitory, but the grave as an eternal abiding-place.

The English army, from the day of its entrance into Egypt to its arrival at Khartoum, will steam through a continual double line of buried cities on both sides of the River Nile. After Memphis, with its great cemetery, has been passed a number of smaller cities follow each other in quick succession, their local names and traditions being well preserved, but there is no place of great importance until Thebes, 600 miles from the sea, is reached. This was the capital of Upper Egypt, was built on both sides of the Nile, and from the numerous canals seems to have been a sort of ancient Venice. The remains of two huge temples comprise all that now remain of the city, which take their names from two local villages, Karnak and Luxor. The Exposition building at New Orleans covers, it is said, an area of nearly thirty acres, and is a temporary building of glass and iron, but the great temple of Jupiter Ammon at Karnak had a covered area of forty acres; the temple enclosure was ninety acres in extent, and of all the thousands of columns that enter into the structure no two are alike. There were many halls in this temple 350 feet long by half that in breadth, and the entire edifice, in extent and grandeur, it is believed, surpassed any other creation of man. It is especially to be remembered that this triumph architecture was erected in the days of Joseph, and was the center of a system of smaller temples which surrounded it for several miles in every direction. The frontier city of ancient Egypt was Assouan, the present city of this name being built on its predecessor, which lies many feet beneath the sand. The old Assouan is especially famous for its inscriptions, many important records having been recov-

ered here. Near the city is the Island of Philæ, the last resort of idolatry in Egypt and in the Roman empire. Here Isis and Osiris were worshipped for over an hundred years after the imperial decrees abolishing the old religions and substituting Christianity in their stead. The most wonderful thing about all the Egyptian ruins is the apparent ease with which the ancient architects and engineers handled the huge blocks of granite, as if they were no heavier than so many bricks. The utter worthlessness of human life and effort in those days is shown by the excessive labor bestowed on the statues, columns and other monumental works, the cost of which to-day, at our present rates, would exhaust the treasury of all the powers of Europe.

Arabia Petra, or the Rocky Arabia, was until comparatively recent times, believed to be a desert even more uninhabitable than the sandy districts, but the investigations of the present century have shown that it once supported a vast population and had a great number of strongly fortified and peculiarly built cities. About four years ago Captain Burton was sent out to explore the region east of the Red Sea and found the lost cities of the Midianites, mentioned in Scripture, and near them very extensive gold mines, which bore evidence of great antiquity, and less than two years ago he took out a colony to re-occupy these cities and work those mines which he considers to be the veritable Ophir of Solomon's time. Petra was first inhabited by cave-dwellers, who gradually improved upon their excavations until the ruins of that district are now among the most remarkable relics of the past. Temples, tombs, palaces, fortifications, and private dwellings are all, without exception, excavated from the sides of high cliffs, and thus form unique structures, the like of which is not elsewhere known. The peculiar architecture is suggested by the character of the country, which is rent into vast chasms 200 or 300 feet broad, and having perpendicular sides of sandstone and limestone. The great cities of this region are always in these chasms, and the ruins of the rock-hewn edifices extend often for many miles. Passing through Arabia and entering Palestine the most notable list of buried cities is found in the capital. The heights of Jerusalem were first held by the Jebusites, who had a fortified city there; then taken by David, who destroyed the city and built another on its ruins. Since then the city has passed through many sieges, and has been time after time destroyed, another rising on its ashes, until the original Jerusalem of David is now many feet underground. The city has been held in turn by the Jews, Assyrians, Persians, Egyptians, Greeks, Romans, Saracens, Crusaders, and Turks, and each change of government was attended with more or less violence and destruction of property. No less than six Jerusalems, one above the other, have been counted by those who sink their shafts for the purpose of making scientific examinations of the ruins. The workmanship of the Jerusalem of Solomon's time bears favorable comparison with that of Greece, Rome or Egypt. In the temple platforms there are found blocks of solid granite forty feet long, ten feet broad and six feet thick, laid upon each other, and fitted so nicely that it is sometimes almost impossible to discover the joint, increasing our amazement at the engineering skill that

could accomplish such wonders. It is impossible to dig a well in any part of the city without having to pass through broken columns, walls, streets, and ruins of every kind for nearly 200 feet before coming to the original soil.

Palestine is almost as much a country of buried cities as Egypt. Some of the most notable of these are the remains of cities rebuilt by Herod the Great, who was an indefatigable architect and levied the most merciless taxes on his people in order to build palaces and monuments to his own vanity. Among the most notable of the small but magnificent cities he built were the Herodium, a fortified country seat, and Machaerus, beyond the Jordan, a palace with surrounding houses, infamous under a later Herod as the scene of the murder of John the Baptist. Hebron, the City of Abraham, is now identified chiefly by the cave in which, according to tradition, lay the bones of the Patriarch and his family. Quite as interesting are the long buried and forgotten, but recently recovered cities of the Philistines, which, though occupying a territory only about half that of St. Louis County, fill more pages in Biblical history than many numerously populated capitals. The Philistine cities are remarkable for the massiveness of their ruins, the doorways being constructed usually of three huge stones, two perpendicular, and the third laid across them. Acre, in all ages celebrated for its strength, was the point where Napoleon received his first check in his Egyptian expedition, and the ruins of half a dozen cities here lie one above the other, while Cæsarea, in the time of Paul the capital of Judea, was lost for ages, and recovered only through the fact of the name being retained in the local traditions of the Bedouins. Jericho, so famous for the concert performance of the trumpets was lost from that day, and to the present can not certainly be located, but is not alone in this respect, since there are hundreds of other cities in Palestine whose history we know better than their geographical position. The most notable of all, however, are the Cities of the Plains, which were destroyed by volcanic eruption when the Dead Sea was formed. Deep down beneath the Dead Sea ruins of great extent may still be seen, suggesting that these cities were not only large but densely populated also, while the character of the surrounding country all goes to show that the Biblical account of the catastrophe was substantially correct. America is not alone in having ruins which possess neither name nor history. Such wonderful cities as Nineveh and Babylon, and the extensive cities of Persia and Mesopotamia are lost and found, and books are printed by the score about them, while moralists muse over the fate of the nations who once rejoiced in them; but it is infinitely more saddening to remember that ruins, covering many square miles have been found in the regions of Western Asia, showing the existence of vast populations who have perished from history so absolutely that not even a name or a trace survives. The land of Moab, east of the Jordan, is full of cities for hundreds of miles, but not a name remains to tell of those who built and inhabited them. On Mount Nebo there are the ruins of a great city not laid down in any map; who built it, who lived in it are unknown. The northern part of Palestine is almost equally rich in ruins which antedate the time of the Jews, but no antiquarian is able to assign hem either a date or a population.—*Globe-Democrat.*

ASTRONOMY.

SUN AND PLANETS FOR DECEMBER, 1884.

W. DAWSON, SPICELAND, IND.

As stated in the November REVIEW, the Sun's R. A. on the 30th was 16 h. 27 m. Hence on December 1st it will be 16 h. 33 m.; and on 31st 18 h. 46 m. The increase being somewhat more than four minutes a day is caused by the Sun moving faster on account of being nearer the Earth than it was near the middle of the year—speaking of *apparent* motion caused by real motion of the Earth. On December 21st at 4 o'clock in the morning the Sun's R. A. is just 18 h.; when it is farthest south (23° 27′). This is the shortest day, and the beginning of winter season. It will be 9 h. 10 m. long in 40° north latitude—longer south of this latitude, and shorter north of it.

At this writing (November 8th) the Sun appears again without spots—the third time in more than four years. The other two times were February 23d and May 27, 1883.

Those who study the westward motion of the stars will observe new constellations in the east week after week; and occasionally a planet appearing earlier than it did in the Autumn time.

On December 1st, at 7 P. M., the Pleiades are three hours high; Aldebaran nearly one hour below; and the Belt of Orion just rising in the east. Capella is away north of the Seven-stars, and Saturn below—making nearly an equilateral triangle with Pleiades and Capella. Jupiter rises about 11 P. M. during the first week of December; being a fine morning star. Venus rises about 4 A. M.—still bright, though waning. Mercury is an evening star this month; being at greatest elongation east on the 17th when it may be visible to the naked eye, though too far south (of west) to be conspicuous. It will be in conjuction with Mars on the 4th and also on the 29th.

The Moon will pass over a fourth magnitude star near 8 P. M. December 4th, and another one near 7 P. M. on the 22d. Both these will be interesting phenomena; and may be observed with very small telescopes—if the sky is clear.

METEOROLOGY.

THE PANAMA CANAL AND ITS POSSIBLE INFLUENCE UPON THE OCEAN CURRENTS AND UPON CLIMATE.

M. O. BALDWIN, M. D.

Referring to the above topic it is hardly necessary to say that the attention of the whole civilized world is, and deservedly so, directed at the present time to this great work and the benefits to commerce and civilization which will result therefrom.

It is not the purpose of the writer to treat of these, but to direct attention to the possible physical changes upon the earth's surface, which may be brought about by the completion of this canal.

The surface of the ocean on the Pacific side of the Isthmus is about fifteen feet higher than it is on the side of the Atlantic. This elevation of the waters of the Pacific above those of the Atlantic is maintained, it is probable, by the peculiar direction of the Pacific Ocean currents, which, while they carry forward to this point very great bodies of water, impede, and to a great extent, obstruct their return. The consequence of this must be that upon the completion of the canal, which is to be, it is understood, a tide water canal, there will be created a current from the west eastward, through the Isthmus.

The length of the canal will be about thirty-three miles, consequently there will result a fall approaching closely six inches per mile. The pressure of so great a body of water as is found in the Pacific, will give to this current in the canal a much greater rapidity than will exist in the current of a stream wherein we have the same degree of inclination. The result of this will be that the shores and bottom of the canal will be rapidly cut away.

Now let us consider briefly the currents of the ocean. There exists in the Pacific Ocean the great Japanese current, which sweeps from the coast of Japan northward and is divided upon the Aleutian Islands, on the coast of Alaska, a portion passing through Behring Straits and a portion finding its way down the western coast of the continent as far south as Central America, where it is deflected westwardly to join and again return with the currents from the South Pacific which are diverted from Australia and the Phillipine Islands and form a current which passes directly eastward to the Isthmus of Panama. This current in its passage eastward is joined by yet other currents from the great South Pacific currents which sweep up the west coast of South America, and together these form the great equatorial counter-current, and the entire force of this mighty stream ...nd expended upon the western shores of the Isthmus.

It is an evident condition that these ocean currents are directed in their course by the coast barriers with which they are brought in contact. If then, these barriers are by any means removed or changed, there will result a corresponding change in the direction of the currents.

We have then this condition, with the waters of the Pacific already at a considerable elevation above those of the Atlantic, a current from the west eastward seems inevitable, and with the added force which will be thrown in by the currents from the Pacific, the canal must be rapidly worn away until it is probable a considerable portion of the Isthmus will have been destroyed, and the great Pacific current, the force of which is now expended upon the western shores of the Isthmus, will find its way through into the Gulf and be joined to the Gulf Stream.

Should this be the result we can only expect that the great thermal currents from the Pacific, which have heretofore so greatly modified the climate of our Pacific Coast will undergo a change in their directions and the great body of heated waters finding its way through the Isthmus will pass northward with the Gulf Stream along our Atlantic Coast until it is directed upon the coast of Newfoundland and crossing the Atlantic it passes the shores of Great Britain and Iceland, expending itself and upon the frigid shores of northwestern Europe, will carry with it an elevation of temperature which will modify to a great extent the climate of those regions.

It is a well known fact that an extended portion of the Arctic world has been at some time habitable and inhabited. This is shown by the finding so frequently the remains of tropical plants and animals in the far north. It is equally known that great convulsions of nature have taken place whereby continents and oceans and ocean currents have been changed, and these conditions have brought about these great changes in climates. It cannot then be considered an unreasonable hypothesis, that the results which have followed natural causes shall also succeed artificial means when the elements necessary are at hand.

Permit a digression, to direct attention to the fact, as has been indicated above, that the current of this canal will be such that in the course of time it will result in the destruction of a considerable portion of the Isthmus. In that case the canal company will find a difficulty in making the investment a source of profit, as the canal will soon have overreached their boundaries, and will become a public highway, a great waterway for the shipping of the world.

THE ATMOSPHERIC HAZE OF 1883 AND 1884.

W. H. PRATT, DAVENPORT, IOWA.

The long continued prevalence of the "red skies" constitutes a phenomenon which at least in point of duration is quite unprecedented. As the months pass and this wonderful effect has not faded away as was expected, the subject assumes

a deeper significance and greater interest, and it is felt that the theories advanced and ably maintained by prominent astromomers and physicists are probably insufficient and untenable.

It was known from actual observation that clouds of volcanic dust could produce, temporarily, various and brilliant colors in the atmospheric reflections. It seemed possible, even plausible, that a comparatively immense volume of such dust projected into the atmosphere by the Krakatoa eruption, might remain suspended for a considerable period, gradually settling to the earth and the effect entirely disappearing within a few months. Such, however, has not been the case.

Over twelve months have passed and although the intensity and duration of the "afterglow" subsided considerably after two or three months, it has since that time continued with considerable uniformity. The dust theory has been largely supported by the discovery, as reported in different localities, of dust similar in appearance to that from the volcano, but we should not forget that this "meteoric dust" had been collected and examined in many places long before the outburst of Krakatoa. The coincidence in point of time—these appearances having commenced soon after the terrible convulsion—has perhaps been in reality the principal reason for attributing their origin to that event.

The fact of the observation of the phenomenon successively at points more and more remote westward from the Indian Ocean has also been cited as favoring that view; but such progression in the phenomenon would probably be the case whatever the cause which produced it, and the observations are too incomplete and uncertain to be at all conclusive. It is becoming very difficult to believe that the bowels of the earth have been so suddenly emptied to such an extent as the phenomena would demand upon that theory, or that the pulverized obsidian or whatever the discharge may be, could remain permanently in suspension. It therefore looks as if that theory must be abandoned.

One other opinion has been advanced and strongly advocated by a few scientific and many very unscientific writers, viz: that the phenomena are due to the presence of aqueous vapor in the atmosphere. They seem, without exception, to have quite forgotten that the same appearances have not been of common occurrence hitherto and must therefore be accounted for if at all, by some new or very unusual conditions.

A communication published in the November number of the REVIEW advocates this view. The writer assumes that the coloration is produced wholly by the moisture in the atmosphere, and curiously enough, that the *less* the quantity of moisture, the *greater* the effect produced! That would seem to be sufficient at once to settle that theory so far as his argument is concerned. His first remark also, concerning the "great commotion" produced in the scientific world, though greatly exaggerating that "commotion," shows that he is aware that the event is something new and altogether unusual, which aqueous vapor in great and small quantities certainly is not. Mr. Noyes suggests no recent change in terrestrial conditions except the development of the modern "Weather-Map." This, as he

very justly remarks is "a new thing." "One of its special beauties" he adds is "that it shows that nature is never twice alike." It will probably occur to every reader that he has heard that remark before the Weather-Map was brought to its present perfection; that is not a new revelation by several thousand years, and in fact has been a truism in all ages.

Doubtless the Weather-Map as now drawn gives a very instructive, graphic representation of the conditions of the atmosphere and the progress of storms, but it is no disparagement of its excellences to say that it has not produced the remarkable sunsets and sunrises and hazy skies of the past year. nor has it at all explained their sudden appearance and continuance, nor their non-occurrence in previous years. He remarks that "here the year 1883 was conspicuous for a prevalence of high-barometer." How then did the color-effect not appear until the last two or three months of that year, the highest monthly averages of barometer of the year having occurred in January and February, seven or eight months before? And why continue ever since?

In fact, however, the Signal Service record at Davenport shows the average height of barometer for eleven years next preceding January 1, 1883, to have been 29.368 inches, while for the year during which the color displays have prevailed, viz.: from November 1, 1883, to November 1, 1884, it has been 29.362 inches; six one-thousandths of an inch *below* the average of those eleven years. That seems to dispose of the theory of "High" as a producing cause.

Doubtless the extremes of maxima and minima of barometric pressure and atmospheric humidity have been as great during the past ages when there were no instruments to measure, nor "Weather-Maps" to illustrate them, as recently, and, as like causes produce like effects, had these conditions been adequate to produce the phenomena, the latter could not have been unfrequent.

The wonderful phenomena in question indicate a sudden and permanent, or at least a lasting change in the condition of our atmosphere, for the origin of which we should perhaps look beyond terrestrial operations, either to peculiar cosmic circumstances or to the progress of some secular changes in our system. When we remember that there are thousands of comets and unnumbered nebulæ, both of which vary from masses of immense extent and brilliancy to such as are scarcely observable with the most powerful instruments, we must believe that there are still almost infinite numbers of masses of nebulous matter, such as that of which comets are composed, not of sufficient size and not as yet sufficiently condensed to become visible. Judging from the comets themselves we must conclude that these small and highly rarified nebulæ are moving through space in all directions. Under these conditions it would be scarcely strange if one of these stray masses should sometimes come so near one of the planets as to be arrested in its flight, and compelled by the mighty power of gravitation to accompany its captor. Indeed, it would be remarkable if this should not sometimes occur.

Should the earth in its course pass near one of these highly attenuated bodies

whose momemtum is almost nothing, the latter must necessarily be caught in our atmosphere and carried along with us. If the repulsion between its particles which had hitherto prevented condensation continued to exist, the filmy mass would gradually spread through or over the earth's atmosphere, attending it as an envelope for some indefinite period, perhaps ultimately to be wholly absorbed. This cosmical matter floating in the upper air or above it would doubtless affect the sun's rays by reflection and refraction as well as directly obstructing them to some extent. It might also modify the structure of the atmosphere itself so as to cause the ordinary constituents of the air to act differently in the transmission of light. That it does constantly obstruct, decompose and reflect the sun's rays in a considerable degree is plainly shown by several facts which are matters of common observation.

1st. On all days when the sky is free from clouds or nearly so, the whole atmosphere in the vicinity of the sun's direction and to the extent of sixty or ninety degrees each way, including fully one half of the visible heavens, shows a whitish haze of dazzling brightness near the sun and diminishing gradually in all directions. On the clearest days this halo around the sun takes a more decided form and color : immediately around the sun an area of intense whiteness, surrounded by a broad ring of reddish brown color. Having spent the past summer on the dry plains of Dakota I have observed the above described appearance very strongly marked throughout the season.

2d. The portions of the sky more remote from the sun and opposite to it have *never*, during the past twelve months exhibited the clear "ethereal blue" so common and so beautiful in clear weather at all seasons of all preceding years. It now constantly presents, at the brighest, but a dull bluish lead color, and

3d. This condition is further shown by the following from the report in *Science*, page 295, of the proceedings of the Astronomical Section of the American Association for the Advancement of Science at the recent meeting at Philadelphia. "One very interesting statement of Mr. Swift to the effect that there had not been a first rate clear sky since the red glows appeared a year ago following the Krakatoa explosion, bears out the general experience of workers in other observatories, especially those who try to see stars near the sun in the day-time."

Whether this remarkable condition of the atmosphere can be reasonably supposed to have any relation to the unusual continued mild and calm weather of the present autumn, is an idea that readily suggests itself, though it may probably be but a mere coincidence. This and many other related questions are as yet unsolved, and the whole subject has not by any means lost its interest.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Oct. 20th to 30th.	Nov. 1st to 10th.	Nov. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min.	32.	25.	27.	28.
Max	75.	79.	77.	77.
Min. and Max	53.	52.	52.	52.
Range.	43.	54.	50.	49.
TRI-DAILY OBSERVATIONS.				
7 a. m.	40.1	40.2	36.0	38.8
2 p. m.	62.0	65.6	59.0	62.2
9 p. m.	47.3	44.6	42.9	44.9
Mean.	49.8	50.1	45.9	48.6
RELATIVE HUMIDITY.				
7 a. m.	.904	. .	. .	. .
2 p. m.	.488	. .	. .	. .
9 p. m.	.805	. .	. .	. .
Mean	.732	. .	. .	. .
PRESSURE AS OBSERVED.				
7 a. m.	29.108	29.185	29.148	29.164
2 p. m.	29.170	29.178	29.123	29.157
9 p. m.	29.157	29.173	29.133	28.154
Mean.	29.233	29.179	29.135	29.182
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles	2105	1774	1939	5818
CLOUDING BY TENTHS.				
7 a. m.	4.8	2.1	4.4	3.8
2 p. m.	5.2	2.0	5.1	4.1
9 p. m.	3.8	1.2	3.7	2.9
RAIN.				
Inches.	3.2	.05	.43	.80

The month's report here given embraces the period of least rainfall yet observed in any month of this year. October during its last decade was very pleasant autumn weather, frosts occurring on the 22d, 25th and 31st. The first snow storm occurred November 18th, but melted nearly as fast as it fell, but up to the 20th no freezing happened at this place which did any damage to root crops.

ENGINEERING.

AMERICAN AND ENGLISH CITY RAPID TRANSIT.

While we have been talking and arguing about speedy means of intercommunication in large cities, a necessity of modern times (not because large cities have not before existed, but because in these days of telegraphs and telephones, of stenographers and typewriters, the rapid interchange of thought and word begets a longing for as rapid transit of matter and of man from point to point), and have given to our own cities and to the world the American surface street railroad or tramway, the slightly more rapid cable road, and the somewhat speedier stilted steam road, our conservative British brethren have quietly studied out the question of demand and supply, of outlay and profit, and have gone on to construct a work which furnishes to their metropolis what we have longed for but feared to undertake—speedy, safe and convenient intramural transit. And, what is more, they have done it without interfering with public property or violating private rights.

The Metropolitan Underground Railway, which traverses the heart of the most populous city of modern times, has been undertaken by capitalists who did not conceive it to be their first duty to seize upon lands which had been purchased by the public for a specific purpose and divert them to another purpose without compensation to the owners of abutting property. They seem to have had the pluck and the foresight to realize that a judicious expenditure to enable them to own the land they occupy, and to construct an enduring work, will prove more remunerative in the long run than a more fragile construction, with the risk, besides, of having to pay damages for encroachment on private rights.

The last completed section of this magnificent work, from the Mansion House to the Tower, a distance of about three-quarters of a mile, has been executed within the last twenty months, and runs "beneath residences, warehouses, and roadways, and in all the difficult labors of underpinning, propping and building there has not been a single accident." Enormous warehouses, containing iron safes and strong boxes, have been tunnelled under without disturbing their contents, and the statute of King William, which, with its pedestal weighs 179 tons, has been underpinned and rests on the arch of the tunnel. Large trees have been undermined and underpinned without removal or injury. The result is that there is a substantial roadway on which the heaviest trains can run at high speed, and passengers can go from point to point in London without creeping along at twelve miles an hour on a structure which sheds bolts and nuts and rivet-heads down on the heads of passers-by, and requires constant repairs, while the gas and smoke and noise offend the innocent dwellers alongside the line of travel.

We doubtless have engineers as capable to design, and builders as competent to execute such work as the Metropolitan Railway as any in the world, but we seem to need capitallists bold and far-seeing enough to appreciate the fact that what New York and other large cities need are permanent roads, fitted for real rapid transit, owning their right of way, and not interfering with public property or individual rights. Whether the structures should be elevated above or de pressed beneath the surface of the ground is a matter of local adaptation and convenience, but the principles of absolute independence of ownership and freedom from complications, on the one hand, with structures owned by the public and maintained solely for their benefit, and on the other hand with rights and privileges acquired by private citizens, partly at public expense and guaranteed to them by the public.

The amount of city travel is proved by experience to grow in proportion to the facilities afforded for it. The construction of the elevated railroads in New York City has doubled the travel on the longitudinal routes in six years. The resources of the elevated and surface roads are now taxed to their utmost, and the necessity is pressing for more and quicker modes of transit.

It certainly seems as if a sensibly designed and honestly executed scheme ought to bring fair profits on legitimate expenses.—*Sanitary Engineer.*

GEOLOGY.

CORRESPONDENCE.

PLEASANT HILL, Mo., November 21, 1884.

EDITOR REVIEW, DEAR SIR,—In the REVIEW for November Prof. J. D. Parker discusses the Burlington Gravel Beds. As I have not been to that place I cannot discuss them. But if Mr. Parker will refer to Vol. III No. 8 p. 460 of the REVIEW he may be interested in an article of mine on "Surface Deposits of Southwestern Missouri and Southeastern Kansas" lying south of the marked limit of "glacial drift." I suppose the Burlington gravel must be of similar age to like deposits along the Neosho to the south, which I have seen. Most of the gravel that I have seen from those beds I can refer to the age of the Upper Carboniferous or Coal Measures. That of Kansas is certainly all of that age, and the gravel deposits all overlie the coal measures.

The gravel on the "Flint Hills" is generally angular or sometimes locally worn; that on the Neosho, Fall River, Walnut, the Valley of the Pottawatomie and the Marais des Cygnes is evidently water worn and the beds generally lie above all known high-water.

Similar deposits exist near the Marais des Cygnes in Bates County, Mo., and

on some ground of a little higher elevation in Bates, Vernon and Jasper Counties, Mo. In Jasper County it may be found on high ground near Carterville and near Carthage.

Deposits of northern gravel (rounded granite, quartzite, etc.) I have found south of the Missouri River in only St. Louis and Saline Counties. But isolated boulders are found near the Missouri River at many places. Rounded boulders of cretaceous and upper carboniferous are often found in the drift of northwest Missouri.

The Ohio and the Missouri I regard as the southern limit of the great northern drift (glaciers). West of the State of Missouri the line trends to the northwest and north.

G. C. BROADHEAD.

PROCEEDINGS OF SOCIETIES.

KANSAS ACADEMY OF SCIENCE.

The first day's session of the Seventeenth Annual Meeting of the Kansas Academy of Science, was held at Lawrence on the 24th ult. The afternoon session was held at the parlors of the Eldridge house, and consisted first of a general business meeting, at which reports of committees were read and officers were elected, and secondly of a session for special business, at which action was taken in regard to the geological survey of the State and in reference to the publication of the proceedings. Reports on the condition of the museum and library were also read.

At the evening session in University Hall the president, Dr. R. J. Brown, of Leavenworth, delivered the following address upon the question:

"IS A GEOLOGICAL SURVEY OF THE STATE A NECESSITY?"

GENTLEMEN OF THE ACADEMY OF SCIENCE:—In accordance with the custom and rule of this academy, the president is required to deliver an address at each annual meeting, upon some subject pertaining to the work of the past year or on the advancement and progress of science in our midst. In response to this the work and labor the members of the academy will be presented to you, as they have come fully prepared with papers of great value and interest, covering al branches of science, with new discoveries and new developments in every department. I congratulate the members of the association upon the success of their efforts to advance the interests of the academy. Time, labor and money have been expended to bring together so much original investigation and research that will be appreciated by scientists everywhere and by the people of our State.

We shall devote the remainder of the evening to something we deem of vital importance to our State. That is a geological survey of Kansas. If we can convince you and through you the great mass of our citizens that there is a necessity that such a work should be made, and that the benefits derived from it will be one hundred times the cost attending the same, our labor in bringing this subject before you will not be without some good results. This Academy was organized for the advancement and promotion of scientific knowledge. In pursuit of it a great many facts in regard to the resources of the State have been made public which have proved of great value to the people of this commonwealth. Take for instance the weather reports by Professors Snow and Lovewell, which have been furnished to the public; the botany of the State by Prof. Carruth; the geological formations by the late Prof. Mudge; besides mineral deposits, insect life, etc., by other members of the academy.

We know little in regard to our mineral wealth. The digging of a well has developed coal, opened up lead mines, brought forth mineral waters, unearthed hidden treasures, etc. If the State should take hold of a geographical survey and prosecute it faithfully the public would find that Kansas possesses within her valuable resources, which now lie idle and unknown. What is there in a geological survey that the farmer, merchant and mechanic should lend his aid and influence in securing an appropriation for this purpose? He might say if coal was found in great abundance in his vicinity, it would reduce the price; if the rainfall could be regulated so they could get it when needed; if frost could come only in winter; if grasshoppers could be kept away; if all the various insects that prove so destructive to fruit and grain could be rendered harmless, a geological survey would be a good thing. We all agree to this, and believe a great deal may be accomplished in benefitting the public that they do not know of now, and much more to the development of the State.

A bill was iutroduced during the meeting of the last legislature asking for a small appropriation for a geological survey. A large number of the members thought it a good thing, but that the railroad bill should pass first. Others said it will cost too much, can't afford it; others asked what is the use of a geological survey? Another said a geological survey is to pay the expenses of collecting old bones and minerals that are found scattered over the prairies. These are some of the objections to a geological survey, showing that the purpose and object are not generally known. Some think it is merely topographical survey, that refers to the surface entirely and has little or nothing to do wtth anything found below the surface. From the various opinions that people have in regard to it, we believe a great many do not understand what a geological survey is, or the benefits to be derived from it. If properly understood we believe there would be no difficulty in securing an appropriation for the work.

We shall endeavor briefly to state what a geological survey is, and some of the advantages of it. It comprises exploring everything on and below the surface, where the most valuable part of the earth may be found, boring and digging into the crust of the earth to any depth that may be necessary to develop everything that

may be of value. Should coal be found, all information in regard to the area, depth, thickness of vein, character and value for heating purposes and probable cost of mining the same would be fully noted.

Location of lead and other minerals, the districts in which they may be found, their depth aud all other information that may prove of value.

Clays of various kinds for the manufacturing of pottery, tiling, brick, etc.

Chalk, limestone, sandstone, gypsum and other materials used for building purposes. Zinc, bismuth, arsenic, strontia and other minerals used in the arts; the cost of mining the same, and their commercial value. Also the botany of the State, showing the distribution of the timber and vegetable growth indigenous to the State, water power on all the rivers and streams and the fall from various points, with such information as will enable every one to understand their availability as water-power for manufacturing purposes. An analysis of all the mineral waters, gas wells, their extent and value, and the practicability of using the gas for fuel and lighting purposes. An examination of the character of the soil from all the counties of the State with an analysis of the same, indicating the soil suitable for the growth of various agricultural productions, in such a way as to be of practical value to the farmer. Rainfall and temperature should be accurately obtained. Considerable attention would be given to the eradication, and means of destruction of insects that are injurious to fruit and fruit trees and prey on the products of the soil: these and a great many other things will be developed that will prove a benefit to our people and of immense value to the State.

County maps should be made, giving a full history of the resources of the county, describing accurately the depth, location, character of all coal deposits, clays, building stone, soils, water-power and all information that would be of value to the counties, and cost of utilizing the same. Publishing maps for the counties, supplying the people with the reports of the survey and disseminating information during the progress of the work. All these come within the range of a geological survey and properly belong to it. To do this work an expenditure of money, not a great deal less than $100,000 during the next ten years will be required to cover the entire expenses of it. In return for this outlay we cannot estimate in dollars and cents the value to the State. We have the evidence of the most prosperous States where surveys have been made, that it has been of untold value to them. It is a work of great importance, benefitting all the citizens alike, bringing prosperity, building up and developing the State and publishing the advantages that we possess now hidden from view; saving thousands of dollars to people who, without any knowledge of what we have, embark in enterprises that may or may not be a success. The useless waste of money would be prevented. With a geological survey, almost a certainty in regard to success would be secured.

If you want to mine for coal, you will know at what depth and in what quality it can be fonnd. If for lead, zinc and other metals, reference to the geological

rvey will tell you; all question concerning the existence of mineral waters, iilding materials, etc., will be fully answered.

At the present time there is considerable interest manifested in regard to the ıking of artesian wells in the western part of the State, which cannot be done ıtil a geological survey has been made, and to delay now would be hindering e growth and development of our State. We believe it would be for our best terests. In order to get the experience of other States that have had geologi-l surveys, I some time ago mailed to the Secretaries of each one of the States the Union a number of questions in regard to the matter, and have received plies from twenty-eight States.

The doctor then read the replies received from these States in regular order, ginning with Maine in the East, and closing with Colorado in the West. All ore testimony to the great importance and value of such work wherever it had een done.

Third day's session opened with the reading of the "Reports of the Commis-on on Chemistry upon the Year's Progress," as follows:

"In Organic and Physiological Chemistry," Prof. E. H. S. Bailey, Law-nce.

On "Technical and Industrial Chemisty," Prof. H. E. Sadler, Emporia.

On "Agricultural and Analytical Chemistry," J. T. Willard, Manhattan.

"Statistics of Color-Blindness in the University," Prof. E. L. Nichols, Law-nce.

On the "Analysis of the Water of the Fort Scott Artesian Well," E. H. S. ailey and E. W. Walter.

"Some Special Tests in Regard to the Delicacy of the Sense of Smell," E. . S. Bailey and L. M. Powell.

The afternoon session convened at 2 o'clock, and papers were presented in e following order:

On "Some minerals of Kansas," E. H. S. Bailey.

On the "Supersaturation of Vapors," Prof. E. L. Nichols.

On a "New Method of Studying Absorption Spectra," W. S. Franklin.

"November Meteors," R. S. Short.

The following valuable paper was then read by its author:

"IS THE RAINFALL OF KANSAS INCREASING?"

PROF. F. H. SNOW.

In the present paper attention is called to the fact of an increase of rainfall ther than to the various theories which have been advanced to explain such crease, or to show that there ought to be an increase.

Geologists, physicists and astronomers are harmonious in accepting it as an tablished fact that the earth in common with all other worlds in the universe is

slowly passing through a series of changes from an original nebular mass of intensely high temperature to an entirely solid mass of low temperature. The sun and the larger planets of our system illustrate the early stages in this series of changes. The earth is in an intermediate condition between the two extremes, and the earth's moon represents the extreme of entire solidity, in which the waters and the atmosphere which once covered and surrounded its surface have been absorbed within its mass, and a very low temperature continually and everywhere prevails. There can be no doubt that the earth is very gradually approaching the moon's condition, and that some time in the far distant future, how many millions of years hence no man can determine, its atmosphere and surface waters will entirely disappear, and a low temperature prevail, even in its tropical regions far exceeding the cold of the coldest Arctic winters in the present age. There can be no doubt, therefore, that, considered with reference to long periods of time, the rainfall of the earth is diminishing. If prehistoric man, 10,000 years ago, had kept scientific records of the rainfall of his time, and it were possible to compare these records with those of the present day, it would be found that a considerble reduction of the average annual precipitation has been made in the period named. Even a thousand years might show a perceptible decrease. But in so short a period as the lifetime of a single generation of men, or even in an entire century, the average annual rainfall of the entire globe has probably been reduced to so slight an extent as to be expressed by a very few hundredths of an inch.

Yet, although the entire movement is in the direction of a reduction of the rainfall, there are without doubt, local oscillations in consequence of man's influence upon nature, which in some cases result in a more rapid decrease than would otherwise be accomplished by the unaided forces of nature, and in other cases within limited areas secure an actual increase in the rainfall. I believe the State of Kansas furnishes an apt illustration of a change of the latter sort. Here the circumstances have been extremely favorable to such a change. Thirty years ago the Territory of Kansas was not occupied by the white man, and if we except a few acres cultivated by the Delaware Indians, no portion of her soil had been turned up by the plough. Her entire area was included within the vast and almost unknown region of the "Treeless Plains" and the "Great American Desert." During that brief intervening period, more than 1,000,000 people, chiefly of the agricultural class, have taken possession of her domain and have already brought her to the very front rank of the States of the Union in the extent and value of her agricultural products.

History affords no other instances of the permanent occupation of so extensive an area previously unoccupied by man by so large an agricultural population in so short a space of time. Here certainly, if human agency could anywhere affect climate, would such an effect be produced. Here, assuredly, if settlement ever increases rainfall, will such increase be most marked and most unmistakable. That such increase has actually taken place, I believe to be established beyound a doubt. It is a circumstance peculiarly favorable to the determi-

nation of the point in question, that although the general settlement of Kansas by cultivators of the soil is of such recent date, reliable observations upon the rainfall had been made at the military posts upon her eastern borders for a sufficient period to make possible a satisfactory comparison between the rainfall before settlement and after settlement. The records at Fort Leavenworth cover the longest period and enable us to compare the nineteen years immediately preceding the occupation of Kansas by white settlers, with the nineteen years immediately following such occupation. During the first period the average rainfall was 30.96 inches; during the second period it was 36.21 inches, giving an average increase of 5.21 inches per annum. Here we have an increase of nearly 25 per cent in the rainfall, under such conditions as to necessitate the inference that such increase is chiefly, if not entirely, produced by causes connected with the introduction upon a large scale of an agricultural population into a previously uncultivated territory. The Fort Leavenworth records cover so long a period of time (nearly forty years), that the increased average of the second half of the period cannot be attributed to a mere "accidental variation." In the issue of *Science* for April 18, 1884, it is stated that "the supposed increased rainfall in the dry region beyond the Mississippi is not borne out by the returns of the Signal Service." But the records of the Signal Service, upon which this statement was based, include a period of only twelve years of observation, from 1871 to 1882, which is undoubtedly too short a period for either establishing or disproving the fact of a "secular" variation. We have also called attention to the fact that causes which have a tendency to secure an increased rainfall, have here been put into operation upon a grander scale than in any other portion of the dry region west of the Mississippi.

But the fact of an increased Kansas rainfall does not rest entirely upon the Fort Leavenworth observations. There are other stations in Kansas whose records cover a much longer period than that of the longest established regular station of the Signal Service. There are the twenty years' records of the United States military post at Ft. Riley, the twenty-four years' records of the State Agricultural College at Manhattan and the seventeen years' records of the State University at Lawrence. If these several periods of observation be divided into two equal parts, in each case it is found that the average rainfall of the second half is notably greater than that of the first half. At Ft. Riley the increase amounts to 3.05 inches per anuum, and at Manhattan to 5.61 inches per annum and at Lawrence at 3.06 inches. Expressed in per cent the rainfall of these three stations has increased in the second half of each period of observation at Ft. Riley, 13 per cent; at Manhattan, 20 per cent, and at Lawrence over 9 per cent. If increased rainfall could be shown by the records of a single station only, or if the several stations, with sufficiently long periods of observation, exhibited discordant results, some indicating a decrease, while others indicated an increase; or, if even a single station indicated a diminished rainfall, the fact of a general increase would lack satisfactory demonstration. But the entire agreement of the four stations, whose records have value in a discussion of this question, seems to es-

tablish beyond doubt the fact of an increased rainfall in the eastern half of Kansas.

There can be no reasonable doubt that the general settlement of the western portion of Kansas will have a similar effect upon its rainfall, but it is not reasonable to expect that Western Kansas will ever boast of a rainfall equal to that of Eastern Kansas. So long as the eastern half of the State remains to the east of the meridian forming the western boundary of the Gulf of Mexico, the south winds will cause it to receive much larger supplies of vapor for condensation into rain than will be received by the western half of the State, which lies beyond the immediate track of the vapor laden winds. It must be remembered that climatic changes are exceedingly gradual and a rain deficiency or excess for a single year, or for two or three years in succession, must not be considered as invalidating the law of general averages. Neither should the fact that the rainfall upon the whole is increasing induce settlers to break land in the western third of Kansas with the expectation of successfully raising the same crops as in Eastern Kansas. Such settlers will surely be disappointed. It is even doubtful if paying crops of any kind can ever be continuously produced in that region. With an average before settlement of about 15 inches per annum, the same percentage of increase as has been made in thirty years would reach an amount of less than 18 inches per annum,—a quantity entirely inadequate to maintain successful agriculture.

Following this paper by Prof. Snow, the papers as given below were read and discussed until a late hour in the afternoon:

"Notes on the Geology of the Spanish Peaks," Joseph Savage, Lawrence.

"Practical Studies in Geology, C. H. Sternberg, Lawrence.

"Sources of the Kansas River Sands," Joseph Savage.

"The Last Submergence and Emergence of Southeastern Kansas from the Carboniferous Seas," E. P. West, Wyandotte.

"Notes on the Geology of Douglas County, Kansas," Joseph Savage.

"The Christening of Amethyst Mountain in Yellowstone Park," Joseph Savage.

"In the Dakota," Robert Hay, Junction City.

Report of the Commission on Mineralogy on the catalogue of Kansas Minerals, Prof. G. H. Failyer, Chairman, Manhattan.

"Notes on a Bison from the Tertiary," Robert Hay.

The following papers were read at the regular sessions.

"Additions for 1884 to the Catalogue of Kansas Coleoptera," Warren Knaus, Salina.

"On the Preparatory Stages of *Hyperchiria Zephyria* Grote," Prof. F. H. Snow, Lawrence.

"Contributions to a Catalogue of Kansas Hemiptera," Prof. E. A. Popenoe, Manhattan.

"On Some Salt Marsh Coleoptera," Warren Knaus.

"On Some Rare Coleoptera from Southern New Mexico," Prof. F. H. Snow.

"List of Kansas Orthoptera collected in 1884," Prof. E. A. Popenoe.

"Report of the Commission on Ichthyology," Prof. I. D. Graham, Chairman, Manhattan.

"Some Kansas Food Fishes," Prof. I. D. Graham.

Additional papers were promised by Prof. D. L. Jordan and others.

"Contributions to a list of Kansas Mollusca," Prof. E. A. Popenoe.

"The Historical Indian," Frank Kizer, Emporia.

"Partial List of Parasitic Fungi of Kansas," Prof. W. A. Kellerman, Manhattan.

"How to Botanize," E. N. Plank, Independence.

"On Generic Characters in Botany, B. B. Smyth, Topeka.

"Vegetation in Western Kansas," Rev. J. D. Parker, U. S. A., Ft. Hays.

"On a Method of Arranging a Herbarium for Popular Inspection," Rev. J. H. Carruth, Lawrence.

"Note on the Coloration of Fluorite at Different Temperatures," Prof. G. H. Failyer, Manhattan.

"Some Kansas Mineral Waters," Prof. G. H. Failyer.

"Fossilized Buffalo Jaws," Prof. Robert Hay, Junction City.

"Effects of Parasitic Fungi upon the amount of Sugar in Stalk and effects of Silo Treatment upon the amount of Sugar in Sorghum," E. B. Cowgill, Sterling

"Notes Upon Gulls, A. P. Fellows, Lawrence.

"November Meteors," Mr. Short, Lawrence.

The officers for the coming year are as follows: President—Dr. R. J- Brown, of Leavenworth; Vice-Presidents—Prof. E. L. Nichols, of Lawrence, and Prof. G. H. Failyer, of Manhattan; Treasurer—A. H. Thompson, of To. peka; Secretary—Prof. E. A. Popenoe, of Manhattan; Curators—O. H. St. John J. T. Lovewell, G. S. Chase, J. H. Carruth, and F. W. Cragin; Librarian—F. W. Cragin.

On Tuesday evening a popular lecture was delivered by Prof. J. D. Parker, U. S. A., upon "Circular Storms," which was very well received by a fair audience.

The discussions that followed the reading of many of these reports and papers were not the least interesting part of the proceedings, and testified at the same time to their value.

The hospitality of the Lawrence members was unbounded, and many of the students of the University and residents in the city participated in the sessions and lectures.

Manhattan was selected as the place for the next annual meeting.

All friends of science will be glad to learn that the Kansas Academy is steadily growing in influence and usefulness, and is likely to become an important factor in the future development of this great State.

MEDICINE AND HYGIENE.

COCAINE AS A LOCAL ANÆSTHETIC.

FLAVEL B. TIFFANY, M. D.

Cocaine, a local anæsthetic which is now engaging the attention of the medical profession throughout Europe and America, is an alkaloid of the *erythroxylon coca*. For nearly thirty years the natives of Peru, the country in which the shrub is indigenous, have used the leaves of the plant when making long journeys, as an exhilarant and a promoter of a greater power of endurance and of respiration. Scientific knowledge of the power of this drug dates only one year back. The Germans first employed it in the examination and treatment of the throat. To Dr. Kohler, a student of Vienna, belongs the honor of discovering this boon in ophthalmic surgery. He communicated this discovery to Dr. Brettaner, of Trieste, who demonstrated its magic power before the last ophthalmological congress of Heidelberg.

It was first introduced into the United States, October 11, 1884, by our distinguished confrere H. D. Noyes, who witnessed the experiments at Heidelberg. Since that time, a little more than two months, all the prominent members of the medical profession here have been on the *qui vive* to test the power of this drug to the utmost. Drs. Agnew, Knapp, and others, have reported of several cases of major and minor operations upon the eye, in which its efficacy as a local anæsthetic was thoroughly proven. Dr. Wm. Olive Moore and more recently many others, have used it with good results in inflammations and ulcerations of the cornea and conjunctiva (front part of the eye-ball). Last Tuesday, November 18th, I used a two per cent solution of the hydro-chloride of cocaine upon a man sixty-seven years of age, for the extraction of a cataract. I made a preliminary application in the morning that I might observe its action. In about three minutes after an instillation of three drops there was complete anæsthesia of the anterior portion of the eye-ball, so that I was able to pass my finger-nail over the front of the eye without the least discomfort to the patient. The anæsthesia passed off in about thirty minutes, leaving no irritation of the eye. In the afternoon of the same day, at the Sisters' Hospital, I used the same per cent solution, increasing the number of drops, and in about three minutes the eye was completely benumbed.

The patient, passing his finger over his eye, said that there was no feeling there: "Doctor you could gouge my eye out now, if you wanted to, and I should not feel it." I then made the operation without the least discomfort to the patient and the results of the operation have been perfect. On Monday the 24th, I again employed it in the same operation on a man aged seventy-nine years

with equally happy results. In both cases there was entire absence of pain in the eye, or swelling or inflammation of the lids, complications not unfrequently arising from nausea and emesis produced by ether or chloroform. On the day following the first operation, November 18th, wishing to test the drug as to its efficacy as a general anæsthetic as well as a local, Dr. E. Von Quast, of this city, experimented with me upon a Guinea-pig with the following results. At 11 A. M. we injected hypodermically one-half minim of a two per cent solution: in three minutes there was a slight dilatation of the pupils, accompanied by a general muscular exhilaration; five minutes later we injected another half minim with no increased effect, then we used three minims with some diminution of sensibiliity. In twenty minutes from the first injection I injected five minims more, which occasioned complete loss of sensibility.

We could now now pass the hypodermic needle through the foot, ears, tongue, or fold of the skin without eliciting the slightest sign of pain or discomfort, whereas before the last injection the pig would squeal piteously whenever the needle entered his skin.

During the entire experiment there was apparently no loss of consciousness, ncr of power of co-ordination, and up to now the pig is none the worse for the experiment. We may at least gather from this that cocaine may be a boon to animals in vivisection.

November 20th I used the solution hypodermically upon myself, some patients and several physicians, with the following general results: With from five to ten minims of a two per cent solution, injected in the forearm, there was almost immediately produced a sensation as of ants running over the skin, a slight numbness of the arm, and complete anæsthesia within a space of one inch from the point of injection. There was some slight exhilaration, a freer respiration, and slightly flushed cheeks. I have, within the last few days employed this agent in subduing photophobia (dread of light) and find it, so far, beneficial. I employed it also in a case of ezcema of the external ear, where there was intolerable itching, with good effect.

It acts like magic in subduring the pain of acute inflammation of the middle ear. It is also useful in reducing the sensibility of the lining membrane of the nose, when necessary to treat the ear through this channel.

Cocaine has also been employed in the treatment of hæmorrhoids, in removing polypi of the nose and ear, small tumors of the skin and in the treatment of diseased mucous surfaces in general with happy results.

KANSAS CITY, December 1, 1884.

BOOK NOTICES.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION FOR 1882, Spencer F. Baird, Secretary. 8vo., pp. 855. Government Printing Office, 1884.

This report, though, as usual with all government documents, nearly two years behindhand in being published, is really an exceedingly valuable work. It comprises the Proceedings of the Board of Regents for the January meeting, 1883, Report of the Executive Committee, the Annual Report of the Secretary, and the General Appendix; which last presents a record of recent progress in the principal departments of science and special memoirs, original and selected, of interest to collaborators and correspondents of lhe institution, teachers and others engaged in the promotion of knowledge. The various departments of science have been ably presented by Prof. Baird himself, Prof. E. S. Holden, Prof. T. Sterry Hunt, Lieut. F. M. Green, Prof. Cleveland Abbe, Prof. Geo. F. Barker, Prof. H. Carrington Bolton, Prof. E. S. Dana, Prof. W. G. Farlow, Prof. Theodore Gill and Prof. O. T. Mason. All of these gentlemen are experts in their several lines of study, and the reader need look no further for a complete statement of the progress made in each department during the year 1882.

If these reports could be published with reasonable promptness they would be of the greatest value to students and others; as it is, they are usually laid upon library shelves as mere works of reference.

PUBLICATIONS OF THE WASHBURN OBSERVATORY OF THE UNIVERSITY OF WISCONSIN, Volume II, Octavo, pp. 400. Democrat Printing Co., Madison, Wisconsin, 1884.

This observatory, founded by the late Hon. C. C. Washburn, is under the directorship of Prof. E. S. Holden, of the U. S. Naval Observatory. Its equipment of instruments is very complete and has been largely increased since the publication of the first volume, notably by the purchase of a Repsold Meridian Circle at a cost of over four thousand dollars, to a description of which some fifty pages are devoted. Also by the purchase of a Sidereal clock, a Howard mean time clock, a six-inch equatorial telescope, and a number of minor instruments. Besides these, the library has received quite an accession, and now consists of about 1,000 volumes and 600 pamphlets.

The work of the Observatory has been extensive and various, both astronomical and meteorological, the latter department having been added in August 1883, when the instruments, etc., of the signal service station at Madison were transferred to it. Few observatories in the country are superior to the Washburn either in the number and value of its astronomical instruments or the amount and quality of the work done.

First Principles of Natural Philosophy: By Elroy M. Avery, Ph. D. 12mo., pp. 402. Sheldon & Co., New York and Chicago, 1884. For sale by M. H. Dickinson, $1.00.

Doctor Avery's Physical Science books have a well deserved reputation for simplicity, clearness and thoroughness wherever they have been used. This little work, the first of the series, is intended for the use of schools in which the course is not full enough to warrant the use of the Author's "Elements of Natural Philosophy," a larger and more comprehensive treatise. The arrangement of topics, the method of their handling and the illustrations are all excellent, and in addition to this the latest developments of science, such as the introduction and use of electrical units, have been freely utilized. The work is divided into nine chapters in which are discussed respectively, matter, motion and force, simple machines, liquids, pneumatics, electricity and magnetism, sound, heat, light. The concluding chapter takes up the subject of energy. The index is copious and carefully arranged.

The younger students will find this an excellent text book and the recapitulatory exercises especially valuable.

The Home Physician: By Luther M. Gilbert, M. D. 12mo. pp. 131. G P. Putnams' Sons, New York, 1884. For sale by M. H. Dickinson, $1.00

This little work is intended for the use of travellers and families at a distance from physicians, and contains much valuable advice and instruction for such persons. It is divided into an introduction in which, among other things, a list of household medicines is given, a chapter on the Uses of medicine, one upon general Observations of Symptoms and Remedies, a third giving descriptions of Disease and Treatment, a fourth upon Surgery, and a final one upon Poisons.

Doctor Gilbert is attending physician at the Connecticut General Hospital at New Haven, and also President of the Medical Board of the same. His experience has been large and his suggestions are based upon an extensive practice. If any fault is to be found with his advice as to treatment, it is that in some of the most serious and fatal diseases, such as croup, and diphtheria, sufficient stress is not given to prompt and vigorous measures. In other respects the advice given is good and rational. For the purposes for which it was written it will be found very useful.

Bulletin of the Museum of the State University of Missouri. Niagara Fossils: By J. W. Spencer, B. A. Sc., etc; Professor of Geology in the University of the State of Missouri. Vol. 1. No. 1. Printed for the Museum, May, 1884.

This bulletin is the first of a series proposed to be issued by the officers of the Museum of the State of Missouri, giving the result of scientific investigation from time to time in this form. This paper includes (Part I) a Monograph of

forty-one species of *Graptolitidæ* (of which thirty are new); (Part II) a Monograph of *Stromatoporidæ*; and (Part III) a description of fifteen other new species of Niagara fossils. The *Graptolites* are plant-like animal forms of much interest to palæontologists on account of their great antiquity and their having long occupied the border land between plants and animals, but the idea of their plant-origin has been abandoned and they are now placed with the Polyps. The forty-one species of fossil Graptolites described in this paper are principally from the Upper Silurian at Hamilton, Ontario. In the introduction the student will find much valuable information in a condensed form in regard to the literature of the history of the study of the Graptolite family, their geological distribution, zoölogical affinity, structure, etc.

After the Graptolites the most interesting fossils of the Niagara formation are the Stromatoporidæ. In Part II. a number of species of this family are described, four of them being new; preceded by a short account of the genus Stromatopora. In Part III, fifteen other new and interesting fossils from the same formation at Hamilton, Ont., are described. Nine plates of about eighty-five good figures, add much to the value of the Bulletin, and will assist the student in identifying the fossils described.

It is to be hoped the officers of the Museum will soon work up the accumulations of the various Geological Surveys of the State of Missouri, which have long remained buried in the University and are now at their disposal. The results of their investigations in this mass of material, given in the form of this Bulletin, will be of great interest and value to scientists, and especially the geologists of this state. L.

PUBLIC RELIEF AND PRIVATE CHARITY: By Josephine Shaw Lowell. 12mo. pp. 111. G. P. Putnams' Sons, N. Y. 1884. For sale by M. H. Dickinson. Paper 40c., cloth $1.25.

This is Number XIII of Putnam's "Questions of the Day" series, which so much attentton by reason of their practical discussions of every day political and social topics. Its author has been and now is identified with the public charities of New York, and, as this work shows, is abundantly capable of discussing the subject. The first chapter gives her personal views on the subject of Public Out-door Relief, the second is a compilation of the various Practices in this direction in England, the third the Practices in Europe and the United States. To these follow the author's conclusions. The second part is devoted to Private Charity, and in it are discussed charitable institutions, principles and rules, methods in city and county, with practical suggestions based upon the author's experience. It is a work of great worth, and we recommend it to the Provident Associations and other public charity societies in the West as a practical guide, or at least, a competent helper in their perplexing and burdensome labors.

A YOUNG GIRL'S WOOING: By E. P. Roe. 12mo. pp. 482. Dodd, Meade & Co., N. Y., 1884. For sale by M. H. Dickinson, $1.50.

We do not know how many novels Rev. Mr. Roe has written, but, judging from the large sales of all of them, he has not yet "outlived his usefulness" nor his popularity. Whatever we may say of such books in general, it is proper to say that the style of the author is attractive and the moral tone of his works irreproachable.

The volume under consideration is no exception in excellence to those preceding it, and is interesting as a story and well written as a literary production.

THE RELIGIONS OF THE ANCIENT WORLD: By Professor George Rawlinson. Sent to any address for 30 cents. J. Fitzgerald, Publisher, 20 Lafayette Place, New York. For sale by M. H. Dickinson.

The study of the religious systems of antiquity, of the forms assumed by religious ideas in their development among the Egyptians, Babylonians, Chaldeans, Greeks, Romans, and other ancient peoples; their mythologies, their curirites and ceremonies, their beliefs as to a future state, etc., is one of the most important and interesting branches of historical research. No more competent guide in this fascinating study could be found than Mr. Rawlinson, the well-known author and Camden Professor of Ancient History in the University of Oxford, and no edition can better meet the wants of the masses than this.

OTHER PUBLICATIONS RECEIVED.

Bulletin of Museum of State University of Missouri: Niagara Fossils, by J. W. Spencer, B. A. Sc. in 3 parts, Vol. 1, No. 1., St. Louis, Mo., 1884. Papers of Archæological Institute of America, II: Report of Archœlogical Tour in Mexico, in 1881, by A. F. Bandelier; published by Cupples, Upham & Co., Boston, Mass. Instructions to Custodians of Public Institutions under Treasury Department, Government Printing Office. Catalogue of Flora of Minnesota, including its Phœnogamous and Vascular Cryptogamous Plants, by Warren Upham, Part IV of Annual Report of Progress of 1883, Minneapolis, Minn. Johns Hopkins University Studies—Herbert Adams, Editor. Second Series XI, Rudimentary Society Among Boys, John Johnson, Jr., Baltimore, Md. Report of Kansas State Board of Agriculture, for month ending Sept. 30, 1884, containing Topographical Description of State, Population, etc., Wm. Simms, Sec'y, Topeka, Kansas. The Health Miscellany, Fowler & Wells, Publishers, New York, 25cts. Address of Commander in Chief, Presented at National Encampment of G. A. R., Minneapolis, July, 1884, Philadelphia, Penn. Department of Agriculture—Chemical Division No. 3. The Northern Sugar Industry, during 1883, by H. W. Wiley, Government Printing Office. Department of Agriculture, No. 4, an Investigation of Composition of American Wheat and Corn, by Clifford Richard-

son, Government Printing Office. Popular Fallacies regarding Precious Metal Ore Deposits, by Albert Williams, Jr. Questions of the Day, XVI: The True Issue, by E. J. Donnell, G. P. Putnams' Sons, N. Y. 1884. Emblematic Mounds, reprinted from American Antiquarian, by Stephen D. Peet. Choice Literature Monthly Vol. 4, No. 21, $1.00 a year, John B. Alden, Publisher, N. Y. The Book Record, October, 1884, Vol. 1, No. 4, J. B. Alden, Publisher, N. Y., 25 cents a year.

The Monthly Weather Service, September, 1884, under direction of Gen'l W. B. Hazen, Thomas W. Woodruff, Editor, Signal Office, Washington, D. C. 1884. *Blackwood's Edinburg Magazine*, No. DCCCXXXVIII, Philadelphia, October, 1884, Leonard Scott Publishing Co., $3.00 a year, each No. 30 cents.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

PREVENTING THE AERATION OF LIQUIDS.—This invention relates to an apparatus for preventing the aeration of liquids in the process of withdrawing them from kegs or barrels, and it consists of a metallic tube formed with joints at suitable points and having at one end a tapering bung-piece within which a correspondingly tapered plug fixed upon a smaller induction tube, is removably secured.

The induction-tube has fixed to one end an expansible rubber bag or similar instrument. Much inconvenience and loss has heretofore attended the operation of drawing fermented liquids, for upon a quantity of the liquid being withdrawn from the cask the atmosphere enters and contaminates the whole.

In operation the induction-tube being attached to the tapered plug and to the inflatible vessel, the tubular bung-piece which is secured to the main tube is affixed to a barrel or cask of liquid, then the rubber bag is folded into a sufficiently small package, and by means of the inflexible induction-tube, it is inserted into the top of the main tube and forced therefrom to the interior of the cask, where it is inflated correspondingly as the said liquid is withdrawn.

Meanwhile the tapered plug has been forced to a tight joint within the tapering bung-piece. By attaching a funnel to the upper end of the induction-tube or by a similar arrangement, ice water may be used as the inflating fluid.

After all of the liquid has been withdrawn from a barrel or keg and it is not desired to apply the apparatus immediately to another, the main tube, together with the attached bung-piece and the induction-tube therein contained are first sufficiently loosened in the bung and then carefully withdrawn until the flexible

vessel (which obviously becomes disinflated by the operation) is clear of the bung-hole, after which it is then, by means of the induction-tube, drawn within the main tube, where, as before mentioned, it will be secure from the ravages of insects and vermin.

The inventor is Mr. J. H. Partridge, of Kansas City.

STOP-VALVE FOR RADIATORS, ETC.—This improvement consists in providing the valve-casing with a removable packing-seat in addition to the main valve-seat and further, with a continuous spindle that is devoid of a screw, and in lieu thereof is provided with a spiral-sping and a locking-lug which operates within a suitable longitudinal opening through the spindle casing.

The object being to construct a stop-valve principally for use upon steam-radiators, that will be quick in action, easy of operation and of simple construction and repair.

A suitable operating handle is attached to a plain valve stem operating within the stem-casing, which latter is provided with a longitudinal slot within which the locking-lug is adapted to operate and, by reason of an annular cam-shaped extension thereof in which the said lug adapted to be slightly rotated, the valve may be securely locked in a closed position.

The connections are threaded in the usual manner, and when it is desired to open the valve, the stem is slightly rotated, thereby releasing the locking-lug and bringing into action the spiral-spring which instantly throws the valve open until its packing-side comes into contact with the seat upon the upper end of the thimble.

The thimble is provided with an annular flange, and is threaded upon each side for the purpose of forming a joint between the base of the spindle-casing and the valve casing.

A number of inclined notches are placed along the sides of the locking-slot, for the purpose of holding the valve at any intermediate point of opening.

The inventor of this improvement is Mr. C. E. McClellan, of Kansas City.

GRASSES OF THE GREAT PLAINS.

Dr. George Vasey, botanist of the department of Agriculture, has returned having spent a month in the arid region of the west, chiefly in northern New Mexico, Colorado, and western Kansas and Nebraska, where he has been engaged in collecting specimens of the indigenous grasses of the country for the New Orleans exhibition, and making observations on the distribution of the different varieties, especially those which constitute the staple of the great pastures of the plains. Of fifty varieties obtained, all but a dozen or so were found in elevated situations on the mountain sides, where there is more moisture than on the plains; but it is among the dozen varieties found on the lower levels that the great herds of the pastoral region find their food, and of these the two varieties

known as buffalo grass and gramma grass, are beyond comparison the most important. These two, with the "blue grass," which ranks next in order, though far below them, constitute from seventy to ninety per cent of the pasturage of the arid region. The "blue grass" just mentioned—which must not be confounded with the cultivated grass of the same name—is found chiefly in low and comparatively moist spots, where it sometimes grows quite rank, attaining a height of three feet and making a good hay or acceptable winter pasturage. Cattle, however, will not eat it while the more nutritious buffalo aad gramma grass are to be had. Of these latter, Dr. Vasey found that the gramma grass (which in the northern territories is sometimes erroneously included under the term buffalo grass) predominates near the margins of the little streams and for some distance away from them, while the buffalo grass is the more abundant along the ridges. In the smaller mountain valleys gramma, as a rule, predominates.

Dr. Vasey estimates the number of cattle that can be pastured on a square mile within the arid region at from thirty to fifty head. He thinks that the produce of some of the wild grasses might possibly be increased by cultivation, and thinks it desirable that experiments should be made in that direction, and in general with a view to ascertaining the capabilities of the arid lands.

Alluding to the prevailing western opinion that the amount of rainfall increases with the settlement of the country and the breaking of the soil by the plows, he said that within the past three years there had undoubtedly been a considerable and successful advance of cultivation over lands formerly regarded as arid, but whether the rainfalls would permanently prove sufficient for agriculture remained to be seen. He noticed, however, that many ten acre tracts of timber planted within the limits of the arid region under the timber culture act, appeared to be doing well, though in some cases he saw tracts where the trees, either from neglect, lack of moisture, or other cause, were dying out.

The boundary between the arid region and the country where the rainfall is sufficient for agriculture has commonly been placed at the 100th meridian. Dr. Vasey appeared to think that it might possibly be placed as far west as the 105th meridian, though the line is an irregular one, being further west in northern than in southern latitudes, and considerably further in the valleys near the longer rivers than in the more elevated regions lying between these streams.—*National Republican*.

THE STATE OF IOWA ONE HUNDRED AND SIXTY YEARS AGO.

The State of Iowa was delineated upon an old globe one hundred and sixty years ago. This globe is over seven feet in diameter and was made of wood, by a Capuchin monk, Father Legrand, in 1720, and is to-day preserved in the public library of Dijou, the French ancestral home of Father Laurent. On the proper place on its huge surface is marked the then known geography of what is now the State of Iowa and adjacent territory, and as elsewhere appears in the report

of the Academy of Science meeting, transcripts of this part of the globe (relating to Iowa) have been carefully made by M. Guignard, librarian of Dijou, and transmitted to the Academy.

What was known of Iowa and what was Iowa 160 years ago? We find the great river flowing by her eastern border and then known as the "Missisipi." Lake "Pepin" is located near St. Paul and is an immense widening of the river, which from this point north breaks into many streams.

The River des Moingona is easily recognizable from its name and course as the Des Moines, and is quite accurately traced, but widens into an immense lake near the Minnesota line, and at a point quite above is marked the spot inscribed, "To this point came the Baron Lahontan." It is probable that the Baron got mixed up in traveling over those marshy prairies, for though he evidently struck Lake Obokoji and Spirit Lake, he evidently got over on the Missouri. This river is down, but it runs parallel with the Moingona or Des Moines, up into Iowa and comes to a sudden end. Between these rivers was the apparent missionary ground of the Jesuit Fathers, for this country is thickly lined with the names of Indian tribes, while north of the Des Moines we find few Indian settlements.

Of the Indians, the Panis appear the most numerous. Others are the Es-anapes, Panibousas, Paoutaouas, Aiaouez, Mahas, Tintons, Osages, Apanas, Panisassas, Cansas, and the Illinois, the latter being put on the west bank of the Mississippi, near St. Louis.

The only bluffs marked on the great river are located near Muscatine and below in Illinois.

There is a river flowing from a Lake Panis in Missouri eastwardly, which is named "Meschasepi," evidently a corruption of or the original of Mississippi.

The Ouabache (Wabash) empties into the Mississippi where the Ohio joins it, and the fathers evidently supposed the two rivers were one and the same.

Fort St. Louis is marked on the Illinois River, about 100 miles from its mouth.

Salt Springs are located very near the celebrated Hot Springs of Arkansas, and it is probable that the famous Arkansas baths had been tried by these early missionaries, let us hope with great relief to those pioneer fathers who were traversing the malarial swamps of the West 200 years ago in the service of their Master.

Many other singular features appear in these *extraits* from the old globe. They are the earliest map of Iowa extant, so far as known, and will be studied with deep interest by students of history and geography. They settle the question of the origin of the name of Iowa's capital and river, which but for the elegance of the present combination should be changed from Des Moines to Moingona. The present name has no meaning; the other name would perpetuate the memory of what appears to have been Iowa's most powerful tribe of Indians.—*Muscatine Journal.*

THE LABORATORY THAT JACK BUILT,

OR THE HOUSE THAT JACK BUILT ON CHEMICAL PRINCIPLES.

A little nonsense now and then
Is relished by the wisest men.

This is the laboratory that Jack built.

This is the window in the laboratory that Jack built.

This the glass that lighted the window in the laboratory that Jack built.

This is the sand used in making the glass that lighted the window in the laboratory that Jack built.

This is the soda that melted with sand compounded the glass that lighted the window in the laboratory that Jack built.

This is the salt, a molecule new, that furnished the soda that melted with with sand compounded the glass that lighted the window in the laboratory that Jack built.

This is the chlorine of yellowish hue, contained in the salt, a molecule new, that furnished the soda that melted with sand compounded the glass that lighted the window in the laboratory that Jack built.

This is the sodium, light and free, that united with chlorine of yellowish hue, to form common salt, a molecule new, that furnished the soda that melted with sand compounded the glass that lighted the window in the laboratory that Jack built.

This is the atom that weighs twenty-three, consisting of sodium so light and free, that united with chlorine of yellowish hue to form common salt, a molecule new, that furnished the soda that melted with sand compounded the glass that lighted the window in the laboratory that Jack built.

This is the science of chemistry that teaches of atoms weighing twenty-three, and of sodium metal so light and free, that united with chlorine of yellowish hue to form common salt, a molecule new, that furnished the soda that melted with sand compounded the glass that lighted the window in the laboratory that Jack built.—*The Age of Steel.*

SPOUTING OIL-WELLS IN RUSSIA.

The principal oil-wells of the Baku district lie at Balaxame or Balakhami, about six miles to the northeast of the town: this is an oil-field about three and a half miles in length by one and a half in breadth. To the south lies a smaller field called Bĕbeabat. One fountain at Balakhani, ninety eight feet in depth, is noted as having been flowing steadily for upward of two years, and still continuing to yield 800 barrels a day. Another well not far off, 490 feet deep, commenced its career by throwing up a jet thirty feet in the air, and then flooding

the land with oil for a considerable distance all around, overflowing other wells and several small refineries, so as effectually to stop their work. The roar of the rushing oil and gas could be heard a mile from the spot.

Various flowing wells are said to yield 6,000 barrels a day, and some far more; but, from the fact that these quantities are generally stated in the Russian measure of poods, it is not very easy to realize what is meant. One pood, we learn, is equal to thirty-six pounds English. Hence one thousand poods represent somewhere about sixteen tons. Accounts have just reached England of an oil-fountain which was struck last December, and flows at the rate of from fifty to sixty thousand poods daily, gushing forth with such force as to break in pieces a three-inch cast iron plate which had been fastened over the well in order to divert the flow in a particular direction. In the same district a huge heap of sand marks the spot where an oil-spring, on being tapped, straightway threw up a column of petroleum to twice the height and size of the Great Geyser in Iceland, forming a huge black fountain two hundred feet in height—a fountain, however, due solely to the removal of the pressure on the confined gas, for there is no trace of volcanic heat. The fountain was visible for many miles round, and on the first day it poured forth about two million gallons, equal to fifty thousand barrels.

An enterprising photographer who was on the spot secured a photograph which places this matter beyond cavil. The fountain continued to play for five months, gradually decreasing week by week, till it finally cleased to play, leaving its unfortunate owners (an Armenian company) well-nigh ruined by the claims brought against them by neighbors whose lands were destroyed by the flood of oil.—*From "The Oil-Supply of the World," in Popular Science Monthly for December.*

EDITORIAL NOTES.

THE present number of the REVIEW is an especially characteristic one, having no less than twelve original articles and communications, by Western writers, covering an unusual variety of subjects and equaling in ability and interest those of any other periodical of similar character in the country. Persons wishing to send off a periodical illustrative of the enterprise, education and talent of Kansas City and its environs should select this number.

WE omitted in our last issue to mention a very important scientific work that is being done at Washburn College, Topeka, Kansas, viz: "The Washburn Biological Survey of Kansas." It is in charge of Prof. F. W. Cragin, who is assisted by other members of the faculty and prominent scientists in various localities in the State. This work has been going on for about one year and the most interesting results have been attained, eliciting the encomiums of some of the best naturalists and biologists in the country. There results have been published in two Bulletins which will receive full mention in our next issue.

A SEVERE shock of earthquake was felt at Salt Lake City, Utah, on the morning of November 10th, at about 2 o'clock. Much alarm was felt but no harm was done. The tremors lasted about ten seconds. At Paris, Idaho, six shocks were felt about the same time, and from then till 4 o'clock. Con-

siderable damage to houses is reported, and people were affected as by seasickness. The first shocks were from north-east to south-west, then a swaying motion from north to south. The succeeding shocks were from east to west.

THE Kansas Academy of Science, a portion of whose proceedings we give this month, had an unusually good meeting at Lawrence last week. This Association is doing excellent work for the State of Kansas, and its recommendations should receive the careful attention of her legislature.

MR. C. A. NEWCOMB, of Colorado, is now in St. Louis superintending the publication of his work upon "The Mound-Builders" which will be ready about December 10th. We bespeak for it a favorable reception, as Mr. Newcomb is regarded as an authority upon this subject by his acquaintances.

DR. D. G. BRINTON, Professor of Ethnology and Archæology, Philadelphia, Pa., offers to receive and answer without compensation, questions relating to American archæology, ethnology and linguistics. He also asks that persons having specimens of an anomalous or unusual character send him descriptions, drawings or casts of them; also that he may be apprised of any typical and well authenticated collections that can be obtained for scientific purposes, and of any promising localities for archæological researches, or of any local publications on these subjects and the names of persons interested in thom.

WE are informed by a member of the Missouri River Commission that he tried in every way to secure early attention to the work needed near this place and urged its importance. The latter fact was self apparent to all. But each member of U. S. engineers said it was too late to begin work, that it could not be completed this fall and the winter ice would destroy it. With their experience the others had to agree in conclusion. An allotment of half the appropriation was made to be used at and near Kansas City, preparations to be made this fall and winter and work commenced as early as possible in the Spring.

PROF. S. H. TROWBRIDGE, of Glasgow, Mo., has been working for some years upon a text-book to represent and explain the practical, objective method of teaching science, and has it now in manuscript ready for publication. As a test of the correctness of his views and methods he has incorporated a few of the representative parts of the work in a little pamphlet and sent it out for the inspection and judgment of scientists among teachers and practical workers, for the sake of receiving their suggestions and criticisms. This pamphlet can be obtained by addressing him by letter or card at Glasgow, Mo. From a hasty glance at it, for it was received just as this issue of the REVIEW was going to press, we are satisfied that the work, of which it is a forerunner, will be found instructive and valuable both in matter and method.

THE National Board of Health has addressed a circular letter to the governor of each State in the union, calling attention to the prevalence of Asiatic cholera in Europe, its steady progress westward from India and Egypt during the past two years, and the danger of its reaching this country in 1885, unless prompt action is taken against its introduction through seaports. The circular advises that no point be left unguarded, for the present facilities for travel afford ample means for carrying the poison everywhere. The governors are urged to begin precautionary work at once, and to call the attention of the legislatures to the matter, and the organization of State Boards of Health is recommended.

THE National Academy of Science held its usual fall meeting at Newport this year, commencing October 14 and continuing four days. The spring meeting must be held, in accordance with the constitution, in Washington, the third Tuesday of April in each

year. The autumn meeting is peripatetic, and has generally been held in New York or Philadelphia. The National Academy acts as an advisory scientific council to the government, and its members are required to perform such tasks as the government may give them without compensation. The number of members is limited to 100, and membership is considered a high honor not easily to be obtained. Among those present were: President O. C. Marsh, professor of palæontology of Yale; Home Secretary Asaph Hall, astronomer of the National observatory; Treasurer J. H. C. Coffin, United States navy; W. H. Brewer, professor of agriculture, Yale; G. J. Brush, professor of metallurgy, Yale; Josiah P. Cooke, professor of mineralogy, Harvard; Edward S. Dana, professor of physics at Yale; Walcott Gibbs, professor of chemistry at Harvard: Julius Hilgard, superintendent of the coast survey; Samuel P. Langley, astronomer in charge of the Allegheny observatory; A. S. Packard, professor of zoology at Brown University; Edward C. Pickering, director of the United States geological survey; Samuel H. Scudder, editor of *Science*, of Cambridge, Mass.; Wm. P. Trowbridge, professor of mechanics at Columbia College, and Francis A. Walker, president of Massachusetts Institute of technology.

THE Cattle Grower's Convention held at St. Louis in the latter part of November recommended, among other things, that congress at an early day relieve the department of the Interior from the supervision and care of the bureau of public lands, and that it, as well as the care of all public lands and their belongings, be transferred to the department of agriculture; and that the Fish Commission, now in the charge and direction of the Smithsonian Institute, be also transferred to the care of the department of agriculture; and that the bureau of meteorology now in the charge of the War department, be also put under the direction and charge of the department of agriculture, and further that the department be then advanced to the full rank and dignity of other departments of our government, and further, that the secretaries of agriculture should be selected, not only for their capacity for organization and administration of public affairs, but also as a pre-requisite requirement that they be familiar with practical agricultural operations and interests, and such officers should, by preference, be selected from that section of country which is pre-eminently agricultural and not from a section the greater interests of which are centered in manufactures or commerce.

FOR three years past there has been considerable excitement over alleged discoveries of gold in Northern Michigan. It now appears that gold has really been found in paying quantities in the upper peninsula, in the vicinity of Ishpeming, and that a number of companies have been formed for mining and reducing the ores, mills with the most modern machinery erected, etc. A rush of prospectors to these diggings is predicted for the next spring.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from* 15 *to* 20 *per cent off the retail price.*

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, *besides, without additional cost, for one year.*

THE *Atlantic Monthly* for December, 1884, presents the following attractive table of contents: In War Time, XXIII., XXIV., S. Weir Mitchell. Over the Andes, Stuart Chisholm. Francois Coppee, Frank T. Marzials. Penelope's Suitors, Edwin Lassetter Bynner. Two Harvests, Helen Jackson. The Lakes of Upper Italy, IV. Combination Novels, George Parsons Lathrop. These are Your Brothers," Olive Thorne Miller.

Among the Redwoods, E. R. Sill. Poe's Legendary Years, G. E. Woodberry. An American Flirtation, Grace Denio Litchfield. Canada and the British Connection, Edward Stanwood. The Contributors' Club. Books of the Month.

THE first number of the *Central School Journal*, a sixteen page (12x9 in.) monthly, devoted to practical education, will be issued about the middle of December, 1884. The *Journal* will be edited and managed by Profs. E. M. Guilliams and S. A. D. Harry, members of the faculty of the Salina (Kansas) Normal University. These gentlemen have had a great deal of experience as teachers in both Public and Normal Schools, and understand the requirements of a first-class Educational Journal.

THE danger of incidental harm to the community, or to certain classes of people, from the increased use of machinery, the extension of public works, etc., is greatly diminished when those who make the laws, and especially those whose duty it is to interpret them, recognize that law is a progressive science; that it is a means, not an end; that when a state of things arises for which there is no precedent, a new precedent must be made. How the most enlightened jurists hold this principle constantly in view, and how the common as well as the statute law is thus made to keep pace with the general advance of civilization, is admirably set forth in the leading article in the *North American Review* for December, "Labor and Capital before the Law," by Judge T. M. Cooley, of Michigan. To the same number, William K. Ackerman contributes some suggestive "Notes on Railway Management," Dr. Schliemann tells what he found in his excavations of the ruins of Tiryns, in Southern Greece, and Principal Shairp supplements his scholarly article on "Friendship in Ancient Poetry" with one on "Friendship in English Poetry." The other articles in the number are, "The British House of Lords," by George Ticknor Curtis, and "Responsibility for State Roguery," by John F. Hume.

Popular Science Monthly, conducted by E. L. and W. J. Youmans, is promptly on hand and contains the following articles: The Reformation in Time-Keeping, W. F. Allen, (Illustrated). American Aspects of Anthropology, E. B. Tylor, F. R. S. School-Culture of the Observing Faculties, J. C. Glashan. Queer Flowers, Grant Allen. Alcoholic Trance, T. D. Crothers, M. D. The Problem of Universal Suffrage, Alfred Fouillée. Cannibalism as a Custom, A. St. Johnston. Starvation—Its Moral and Physical Effects, Nathaniel E. Davies, L. R. C. P. The Chemistry of Cookery, W. Mattieu Williams. The Perils of Rapid Civilization, C. F. Withington, M. D. Religion and the Doctrine of Evolution, Frederick Temple, D. D. Liquefaction of the Elementary Gases, Jules Jamin. The Oil-Supply of the World, II. Oddities of Animal Character. Biographical Sketch of Edward B. Tylor, (With Portrait). Correspondence. Editor's Table: Science in School Management; The Abuse of Political Power; A Jewish Explanation of Jewish Success. Literary Notices. Popular Miscellary. Notes.

THE exceptional success of the Christmas Number of *Harper's Magazine* last year has led the editor and publishers to attempt this year to disappoint the public agreeably by giving them a still finer Number. The December issue contains no less than six separately printed plates, besides several other full page illustrations, the frontispiece being a reproduction, in the highest art of the wood-engraver, of the charming picture of the "The Boy Jesus in the Temple," by Prof. Hofmann of Dresden, one of the chief contributions of modern painting to religious art. The engraving is the work of W. B. Closson, from whose graver comes also in the same issue a reproduction of the "Flora" of Titian. The literary and artistic contents otherwise furnish an extraordinary and delightful variety of sketch, story, poetry, art, and music; while in the Easy Chair Mr. Curtis writes of "John Bull and Brother Jonathan at the Christmas Fireside;" and in the Drawer Mr. Warner has a pleasant prefatory word as to "The Universal Christmas Feast."

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

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GEOLOGY.

THE LAST SUBMERSION AND EMERGENCE OF SOUTH-EASTERN KANSAS FROM THE CARBONIFEROUS SEAS, OR THOSE EFFECTING THE CARBONIFEROUS FORMATION IN KANSAS.[1]

E. P. WEST.

The country along the line of the Southern Kansas Railway, all through southeastern Kansas and extending westward to Harper, the present terminus of the road, is unsurpassed in beauty and the fertility of its broad fields and valleys. It is said, and truthfully, to be the paradise of the husbandman and stockman, and it is no less so of the geologist, the poet, and the artist.

Whoever has traveled over the line of this road cannot have failed to observe the picturesque and poetic beauty everywhere meeting the eye. Symmetrical mounds rise from the broad plains and valleys, as if by the work of magic, and terraced cliffs, terrace rising above terrace in solemn grandeur, environ the road. Sometimes the cliffs are circular, forming vast amphitheatres extending back for miles. These mark the last emergence of southeastern Kansas from the carboniferous seas, and bear unmistakable evidence of powerful and persistent forces which, though perhaps, comparatively brief, have left their impress boldly written on every feature of the country.

1 Read at the Annual Meeting of the Kansas Academy of Science, November, 1884.

Water-worn pebbles, commonly known as gravel beds, are found in the channels of streams, in the valleys under the soil, and over the highest mounds and ridges, all over the country. They are encountered north of Ottawa, and extend southward into the Indian Territory, westward to beyond Burlington, and eastward into the State of Missouri. How much beyond the limits indicated they extend I am unable to say, but it is probable that their range is much wider. This, however, can only be determined by an exploration of the adjacent country. Independent of their scientific significance, these beds are important in an economic point of view, affording free underdrainage and supplying good and convenient material for road-making. Along the bases of mounds and cliffs, and often for a considerable distance removed from them, as well as on the tops of the highest ridges and mounds, at and near the surface, the rocks often stand vertically to the plane of stratification, or inclined at various degrees from this tine. This is notably conspicuous in many places.

Not unfrequently old landslides are to be seen projecting from the mounds, or the brink of cliffs and extending out for hundreds of feet. Indeed, the whole country wears the appearance of having once formed the bed of shallow seas, divided into numerous channels of various widths, some of the cliffs during the recession of the waters perhaps forming coast lines while the higher lands may have been low islands. Such is the condition of things conspicuously marked over the entire area named.

To what cause is this grand work to be attributed? It could not have been done by rivers, for the pebbles, though water-worn, are too widely distributed for the work of the broadest of such streams. It was not effected by glaciers, for the vast land-slides, the conformation of the mounds and cliffs, the vertical position of the rocks, where the stratification has been disturbed, the absence of erratic rocks, and the lack of the commingling of the local rocks, all preclude this idea. If it had been caused by glacial action there would have been an intermingling of all the rocks torn down, indifferently. This, however, is not the case anywhere in the district observed. Neither are the beds composed of altered drift, for if they were so they would be homogeneous in their general distribution; but this is not found to be the case, for in some localities they are composed of chert alone, while in others they contain small broken fragments of sand-rock alone, in each instance identical with the adjacent local rocks. No erratic, trap, or igneous rocks, or limestone is anywhere to be found intermingled in the beds. The absence of trap and igneous rocks is accounted for from the fact that the glaciers did not extend so far south. The absence of limestone, though the prevailing local rock of the country, will be explained further on. It was not caused by volcanic action, upheavals, or folding of strata, for the under strata rest undisturbed.

Though evidently not caused by any of these agencies, the mounds, the terraces, the cliffs and the water-worn pebbles, and broad plains and valleys, are conspicuous, grand, and picturesque, facts which stand out in bold relief in the entire district, and prove a wide-spread destruction of its former surface. The

whole country, indeed, has been denuded for, at least, from fifty to two hundred feet in vertical thickness, leaving the more impregnable mounds and cliffs, the pebble beds, and broad plains and valleys, standing monuments to bear witness to the general destruction which, in a past age, took place. The power which caused it must have been great and persistent, and can only be determined by the evidence it has itself left impressed on the field of its operations, and which if correctly read, will, unerringly, lead to its detection. This reading points clearly and unmistakably to water aggregated in broad and shallow seas as the author of the stupendous work. The deposits of pebbles, clays, and soils, the great landslides, the mounds, cliffs, and terraces, and the inclination of the disturbed rocks, marking the country so persistently and conspicuously, could have been caused in no other way.

These seas were, no doubt, connected with an ocean, or deeper and more extended waters, lying to the southward and westward; but at what era of geological time is somewhat uncertain, except that we know it must have occurred since the carboniferous age, for the upper coal measures and Permian rocks are those destroyed.

Co-extensive with this area of devastation, as far as I have had an opportunity to examine it, and, I presume, co-extensive with its entire limits, there is scattered over the country, resting upon the surface or buried under the recent alluvial deposits, silicified wood which grew at a time intermediate between the carboniferous vegetation and our recent forests. The carboniferous wood is invariably imbedded in the stratified rocks, while this intermediate wood is invariably upon the surface, as resting under recent alluvial, or vegetable deposits. This would indicate that portions of Kansas, at least, were covered with forests at the time this widespread destruction began, and subsequent to the carboniferous age, portions of which must have been swept away and destroyed by the submergence of the country, while other portions of it, where the conditions were favorable, were silicified in the mineral waters of the seas and left scattered over the old sea-bed, in positions at or near where it is now found, when the land for the last time, in southeastern Kansas, emerged from the water.

The petrified remains of this intermediate forest, when its limits are fully known, may give some clue to the time of this era of denudation. To the westward, in the region of middle Kansas, the bones of species of animals now living, and the remains of man, have been found buried under alluvial deposits of wide occurrence, and at considerable depth below the surface. If the intermediate fossil wood should be found, as it probably will be, associated with these buried remains, it will render the probability great that this era of waste was comparatively recent, and that man may have reposed under the shade of the forests which preceded it, and which were involved in its devastations. But there is an equal probability that it may have occurred at an earlier date of the world's history.

This last era of submersion in Kansas seems to have been one of destruction, for no fossil remains of sea-life seem to have been left to indicate the age of

its occurrence, and to determine this, resort must be had to preceding life, or to synchronous air-breathing animals which may have been carried out by ocean currents and buried under their deposits.

The absence of life, or the fossil remains of life of this era are not to be wondered at when we consider the wide-spread destruction which took place in it. All of the lime rocks which were torn from their beds were destroyed, utterly, either by the chemical action of the acids in the water, or ground up by the attrition caused by waves and currents, or, most probably, by both of those causes combined, and carried away, in part, to distant and deeper waters, and in part left to form the soils of the local valleys. The more enduring silica was rounded by the action of the water and left in the beds so widely distributed over the country.

Where the destroyed strata were composed of limestone alone, no pebbles are be found, but where the lime rocks contained masses of chert, or where the strata were composed of chert entirely, the pebbles are found, and the beds vary in thickness in proportion to the amount of material torn down. Where the destroyed strata are in a locality of sand rock, and composed of sand rock alone, the gravel beds are composed of their fragments alone. There may have been, and undoubtedly there was, some drifting together of the pebbles, caused by the waves and currents of the sea, but in the main they are confined to the locality where they were torn down, and are nowhere of any considerable thickness.

There are now in the museum of the University of Kansas perhaps a hundred specimens of fossil shells collected from these beds at various and widely separated localities, identical with the undisturbed fossils of the respective localities where they were found, and which prove conclusively, if additional proof were needed, that the pebbles composing these beds are but the more enduring parts, or silica, entering into the composition of the local rocks destroyed. The silica, being impervious to the acids which aided the destruction of the lime rocks, remains imbedded where showered down from the general ruin, and as left when the land emerged from the water except where the beds have been since locally altered, to a limited extent, by rivers and other streams of water cutting through them.

[illegible] erosion, and changes in the elevation of land of continental [illegible] during the Tertiary time; but it is not probable that all the [illegible] the same time, and we must look to the respective changed [illegible] ages when this work was done. In this [illegible] southeastern Kansas only, and have attempted to [illegible] of things wrought out by natural forces in it.

NOTE.—This subject will be continued in the next number of the REVIEW.

PRACTICAL STUDIES IN GEOLOGY.[1]

CHAS. H. STERNBERG.

Geology is a world study, and takes the earth as soon as it was cool enough to allow the atmosphere to disgorge its contents on the steaming earth.

Then began the operation of natural laws, and the causes and effects, as we see them to-day. The rain fell in torrents on the steaming earth, and washed away the solid rocks, and in shape of clay or sand the streams carried it to lower levels and deposited it on the bottom of the sea, as sedimentary rocks. The study of geology is the grandest of the natural sciences, not only because it takes into consideration the largest object with which we have to do, but it includes vast lapses of time, so long in fact that if it does not prove that time is eternal, it shows it least that it is very old. The text-books of the geological student are the solid rocks in which the Creator has written in never fading characters the history of each succeeding period, its life, climate, depth of sea, etc. All the natural sciences bring from their store-houses things new and old to increase its interest. If we go to the sea-shore, and notice the shells lying on the beach which an incoming wave covers with sand, or mud, we see the process by which fossils are made. The sea may come in and by pressure convert the sand, or mud, into solid rock, and the shells will be indefinitely preserved, and they represent existing species.

If we notice the accumulations at the mouths of great rivers, like the Mississippi, we find, mingled with the sand, or mud, trunks of trees, bones of animals, etc., that have been drifted from the far interior, a thousand miles perhaps. These are mingled with shells and sea-weed from the sea-shore, and represent the life of a continent. The sand and mud may, by pressure, be converted into rock, and the relics be preserved for ages. Petrifaction will take place. This is a slow process: as the contents of the organic cells decay they are carried away by water, which holds silica in solution; this is deposited in the empty cells, making a perfect cast, and so cell after cell is built up of silica. This as I said is a very slow process. In Pliocene time the bones are but partially petrified, while only in the older formations are they completely silicified. Another way nature has of preserving her records is by making casts of shells, leaves, sea-weeds, etc.; a leaf falling in the soft mud is covered up, and a perfect cast made of both sides. In some formations the lime of shells has been entirely carried off, and only casts remain. If we go to Florida we will see the process of rock making. Shells are mingled with the remains of others that the waves have ground to powder, which acts as a cement binding the shells together, strong enough to use for building material.

If we go into the hills and find in the solid limestone shells, sea-weeds, etc.,

1 Read before the Kansas Academy of Science, November, 1884.

we can but acknowledge that they represent the life of the period, when as soft mud, this limestone was lying in the bottom of the ocean. And so by natural causes have all the geological records been kept. Many people suppose that the study of geology is dry and stupid, of old bones and rocks. But there is no wider field for the imagination than to people the old seas and lands with animals restored from their buried relics, to clothe the ancient lands with verdure, and map out the continents, study their physical geography, the depth of the sea, climate, and above all to study the introduction and succession of life on the globe and other manifold changes brought about in the animal creation, their development from lowly forms, and their progression through successive changes, until the present state of perfection has been brought about. Life is too short to study the changes brought about by the lapse of countless ages. Mountains have been elevated, valleys hewn out, chasms drilled through the hearts of mountains and many other grand phenomena. The early geologists divided the world's history into distinct periods, supposing that at stated times whole genera were swept from the face of the earth, and new ones created.

These periods have been divided into *Palæozoic* or ancient life; *Mesozoic* or middle life, and *Cenozoic* or recent life. The first period in *Palæozoic* time is the *Silurian* or age of mollusks, and the enormous belts of limestone laid down attest to the abundant shell-life of the period. This was followed by the *Devonian* or age of fishes. They were all cartilaginous, and but few of their remains are preserved, the *Lepidosteus*, resembling our common gar-pike, then appeared, as well as sharks and rays. The last period in *Palæozoic* time is the carboniferous or age of coal plants. The air was dense with carbonic acid, and the luxuriant plant-life cleared the air of this poisonous gas, and stored it away in the great coal fields. Among the plants were the *Sigillaria, Tree Fern, Horse-tail, Cycads,* etc. The ground, and fallen wood, was covered with sponge-moss. At times the sea came in and covered the organic mass with sand, or mud. The rulers of the estuaries were great placoderms. They were clad in armour of bony plates, resembling shields and bucklers. Sharks and rays, with huge frog-like batrachians, were abundant. At the close of *Palæozoic* time *Cenozoic*, the age of reptiles, began. The first period is called Jurrassic, from the Jura Mountains. Here both on land and sea, enormous reptiles reigned supreme, and America has furnished some world-renowned monsters. In the Rocky Mountains, for a number of years, large bones have been found. People supposed them to be fragments of fossil wood.

In 1877 Professors Marsh and Cope made important discoveries, and published the results of their labors, thus adding another chapter to American palæontology. These were the largest known land animals and are called Dinosaurs. The larger ones reached a height of twenty-five feet and sixty feet in length. They were plant-eaters and fed on the leaves and tender branches of the luxuriant forests through which they wandered. The carnivores or flesh-eaters were smaller, and more elegantly built for springing on the clumsy herbivores. They had on each jaw a single row of recurved, serrated teeth. The plant-eaters had several

rows. In the Judith River group the *Dinosaurs* walked erect; their front limbs were small, and armed with claws for grasping the branches of trees on which they fed. A ponderous tail helped to support their enormous weight. They had three rows of teeth in each jaw, with a magazine below each old tooth, containing five young ones. As fast as one row wore off another took its place. We found thousands of these cast-off crowns. The second period is called the Triassic. Here huge reptiles on sea and land were the ruling types. Some are called Labyrinthodonts from the peculiar manner in which the enamel of the teeth is folded. They were clad in armors of bony plates. Crocodile-like animals, with beautifully sculptured bones were common, as well as sharks, gars, etc.

In northern Texas the beds are made up chiefly of red clay, which is so finely divided that all the waters flowing from them, hold it in solution. During high water or on windy days, the water is as thick as cream. The next period is the Cretacous when the chalk of England and America was laid down. The first group in the west is called Dakota, by Prof. Hayden. The formation of red-sandstone, and variegated clays, were laid down in an open sea dotted here and there with islands. The formation enters Kansas near the mouth of Cow Creek, extending in a northeasterly direction through the State, Nebraska, Minnesota, British America and so on to Greenland. The trees, like those in our existing forests, then appeared. Here flourished the magnificent Red-wood, *Catalpa*, *Menispermites*, Tulip-tree, Cinnamon, Fig, *Sassafras*, etc. They left impressions in the sandstone of Kansas and Nebraska, and some two hundred species have been described by the noted palæontologist Prof. E. Lesquereux, of Columbus, Ohio.

During the Niobrara group great beds of chalk and blue shale, were laid down in western Kansas. Here appeared the first bony and edible fishes: *Portheus Molossus*, Cope, reached a length of twenty feet. It had a large bull-dog-shaped head with fangs projecting four inches from the mouth. It had another weapon of offense and defense in the shape of pectoral and dorsal fins, three feet long. In some species, one edge is serrated, and even in their fossil form are hard enough to be used for splitting wood. Another peculiar species was Cope's *Erysicthes* or snout fish. It used this weapon as a modern sword-fish does its sword. But the rulers of the deep open sea were the Saurians or sea-serpents. Cope's *Liodon poriges* reached a length of eighty feet. It had four powerful paddles, which by the aid of a long eel-like tail enabled it to go through the water at great speed. Its weapon of offense was a long bony snout, that was used as a battering-ram.

Clidastes tortor, Cope, was a small animal, about forty feet in length. It was provided with an additional set of articulations in the vertebræ to enable it to coil up, like a snake. Marsh's *Clidastes pumulus* was only twelve feet long, and doubtless often fell a victim to the sharks and other rapacious fishes that abounded in these waters. One peculiarity of these Saurians was that they had no expansible gullet, as in modern serpents; another method was given them in the shape of hinges of the ball and socket pattern just back of the dentry-bone. This en-

abled them to expand the cavity of the mouth and swallow large morsels, through a pelican-like throat.

The most interesting fossils found in the rich beds of western Kansas are Marsh's toothed birds. His *Hesperornis regalis* reached a height of nearly six feet. The wings were not developed. They were swimmers and lived on fishes. They were provided with a row in each jaw of sharp, reptile-like teeth, and thus nearly approach them. Many suppose that they were derived from reptiles; another proof is in the oldest of all birds, that had a long vertebrate tail; and the most important discovery in this line was made by Prof. Marsh this year in the Rocky Mountains, having found a small Dinosaur that walked. The metatarsals and carpals were united, as in all modern birds.

Great flying dragons, or *Pterodactyls*, were common, with stretch of wings of twenty-five feet. They were toothless and Marsh has made the new genus *Pteranodont* for them. Another very unique species was Cope's *Protostega gigas*. It measured twenty feet from one flipper to the other, and instead of the ribs being expanded and united, as in modern turtles to form a shell, they were separate. Instead of a shell, they were provided with great dermal plates, an inch thick in the centre, two feet in diameter and beveled off to a thin figured margin. One specimen found by my party in 1877 weighed 300 pounds after the matrix was removed. It was eighteen inches from one condyle of the lower jaw to the other. Great oyster-like shells, twenty-seven inches in diameter, were found. But we must leave this interesting group to go on to Cenozoic time, the age of mammals, which is divided into three periods—Eocene, or early dawn; Miocene, or middle dawn, and Pliocene, or recent dawn of the existing state of things. Great mammals roamed through the dense forests of the Rocky Mountain region, which was a level swampy country. The temperature was tropical, and plant-life luxuriant. Here we find ample material for the study of the ancestors of modern animals. The horse had many ancestors, and their remains have been eagerly sought for. In early Eocene time he appeared no larger than a fox, with five toes on the hind feet. The folds of the tooth enamel were simple; later on he had discarded his two side toes and walked on three, later still only one toe on each foot was in functional use. The side toes were like the dew claws of a dog. The enamel was complicated and resembled that of the recent horse, that has only the rudiments of these side toes in the splint bones, and so the ancestors of other animals have been traced. The camel has two toes, and the two metatarsals and carpals are united, a medullary canal extending the whole length of the bone on each side. I was so fortunate as to find a camel in the miocene of Oregon that had the two metatarsals and carpals entirely distinct. In the Loup Fork Pliocene I have been employed the present season, for the U. S. Geological Survey, and have been remarkably successful.

My party having procured 15,000 pounds of fossil vertebrates. They consist chiefly of three species of rhinoceros, the mastodon, camel, horse, a small ·eer, lion, etc., all from one locality. Great numbers of bones have been washed ·me river into a deep hole, in the lake, and everything in connection with

them prove that the place of death was but a short distance from that of burial. The bones were scattered through sand on a bed of calcareous sandstone. Rhinoceros bones were the most abundant; Cope calls them Aphelops. They were without horns, and had large sharp canines in the lower jaw, and also in the premaxilla. These were oblong in shape and ground against the lower ones, keeping them always sharp.

In some cases, the premaxilla was several inches longer than the nasals, and had doubtless a flexible trunk. They had three toes on each foot, and were about the size of existing species. These beasts lived alone in herds, no other animal, no matter how fierce, would care to attack or associate with them, for in addition to their sharp tusks, their skin was thick and folded. The bones were indiscriminately mixed. It was not uncommon to find camel vertebræ between the branches of the lower jaws. We found several skulls with lower jaws attached and one perfect front foot. All the others were scattered, except the Tibia and Fibula that were anchylosed together.

A large mastodon lived at this time with inferior tusks. In 1881 I discovered a perfect lower jaw, that measured five and a half feet from the point of the tusk to the angle of the jaw; the jaw was four feet long. This season I procured four upper teeth together in fragments of the maxilla. The largest was seven and a half inches long and three inches wide. Turtles were also common; in 1881 I procured twenty specimens from a narrow gulch. Some of the shells were beautifully sculptured. They were all land and fresh water turtles. But time will not allow me to go more into details. If I have been so fortunate as to interest some of you enough to go more deeply into the subject than I have to-day, I shall be most happy.

THE NEW ARTESIAN WELL AT FT. SCOTT, KANSAS.[1]

E. H. S. BAILEY AND E. W. WALTER.

Some months since a company was formed at Ft. Scott to sink a well for the purpose of obtaining gas. The well was bored to a depth of 621 feet, and although gas was not found, an abundant supply of water was struck.

The well was bored on the first bench on the south side of the Marmaton River, at the foot of the bluff and 550 feet from the channel. Above the mouth of the well is a bluff consisting of limestone, hydraulic cement rock, coal, fire-clay, and bituminous shale. The diameter of the well is eight inches down to 335 feet, to which point the well was tubed with iron pipe. Below that point the well was bored dry forty-five feet, at which point a fourteen inch crevice was struck and salt-water rose to within ten feet of the surface. The boring was continued till a depth of 621 feet was reached, and on removing the drill a clear steady flow of over 10,000 gallons of water per day was obtained. There seems

1 Abstract of a paper read at the Meeting of the Kansas Academy of Science, 1884.

to be a continuous flow, with but little gaseous agitation. The pressure wi carry the water to a height of five feet above the mouth of the well. The wat remains at this height till the altitude is diminished.

The drill record, which follows, as well as other interesting facts, were furr ished by E. F. Nave, Esq., of Ft. Scott:

Wash-Dirt	25	feet.
Clay	5	"
Soapstone	15	"
Slate	3	"
Coal	2	inches.
Soapstone	15	feet.
Slate	2	"
Coal	2	inches.
Soapstone	17	feet.
Blue Limestone	3	"
Soapstone	95	"
Soft Sandstone	5	"
Soapstone	70	"
Brown Sandstone	25	"
Grey Sandstone	7	"
White Sandstone	25	"
Slate	12	"
Fire Clay	4	"
Soapstone and Clay	10	"
Slate and Iron-pyrites	5	"
Flint	23	"
Flint and Limestone	14	"
Crevice	14	inches.
Limestone	4	feet.
Limestone and Flint	75	"
Very Hard Flint	5	"
Mixed Flint and Limestone	156	"
Total	621	feet.

An analysis of the water shows it to have the following composition; the weights being estimated in grains per U. S. gallon of 231 cubic inches:

Hydro-Sulphide of Sodium	.188	grains.
Chloride of Sodium	79.471	"
Bi-Borate of Soda	2.204	"
Chloride of Potassium	Trace.	
Chloride of Lithium	Trace.	
Chloride of Magnesium	7.987	"
Chloride of Calcium	.787	"

Sulphate of Lime	.829	grains.
Bi-Carbonate of Lime	14.238	"
Bi-Carbonate of Magnesia	.305	"
Bi-Carbonate of Iron	1.006	"
Sulphate of Soda	Trace.	
Silica	.951	"
Organic Matter	1.166	"
Total Solids	109.132	"
Sulphuretted Hydrogen Gas	Trace.	
Carbonic Acid Gas	Trace.	
Temperature of Water	67½°.	

This may be classed as one of the sulpho-saline waters, containing borax and lithium as rare ingredients. Comparing this water with that of other springs and wells, we find it to be similar to the celebrated "Blue Lick" Spirng of Kentucky, except that the Ft. Scott water is more dilute and the former does not contain borax. From a consideration of the strata through which the well passes and the composition of this water, it seems probable that it is a mixture of waters from different depths.

UNIVERSITY OF KANSAS, Lawrence, December, 1884.

ENGINEERING.

THE STREET PAVEMENTS IN KANSAS CITY.[1]

W. B. KNIGHT, C. E.

There is nothing more characteristic of a city, and nothing which in such a conspicuous manner marks the distinction between a city in fact and a city in name, than the condition of its public thoroughfares. It is a sign more extensive and obtrusive than any other kind of public improvements. The difference between a clean, smooth, easy riding carriage-way and the rattle and jolt over a rough roadway with varying conditions of mud and dust, must inevitably form an important factor in any estimate or judgment of a city. It is, perhaps, a difference which may rank even with climatic influences in effecting the prosperity, temperament and other characteristics of a population.

Well paved streets in a city are at once the exponent of its commercial vitality and a mark of the wise exercise of municipal power for the conservation of a most important element of that vitality; an element as important to the health,

1 Read before the Civil Engineers' Club of Kansas City, November 29, 1884.

growth and prosperity of the body politic and commercial as the free circulation of blood in the veins is to the individual man.

It is the object of this paper to describe as briefly as may be done, the manner in which this city has paved its streets, the conditions precedent and relative thereto, and the extent to which this kind of public improvement has been carried in the short space of two years and a half.

Kansas City is divided topographically into two distinct parts, the main portion of the site being a high, broken ground, elevated 100 to 200 feet above the Missouri River, and the smaller portion being level "bottom land" lying beyond the base of the bluffs and only about twenty-five feet above low-water mark.

The soil of the upper town is a rather yellowish clay containing generally a small proportion of silica, and most of it is suitable in its natural state for making brick of fair quality. Some of it, however, contains too large a proportion of lime. It is very compressible in its natural state, rapidly forms into ruts and depressions under ordinary traffic on newly graded streets, even where formed entirely by excavation. It softens easily and becomes slippery, and is of greasy appearance. when moistened. Flowing water washes it away rapidly and carries a large proportion of it in suspension to fill up low places when the current is checked. It cakes to a hard crust under influence of drought and summer suns, pulverizes to fine dust under traffic, and cracks open during the severe frosts of winter.

The street gradients in the main part of the city may be stated as ranging from two to five per cent on the north and south streets, and generally about half as great on the streets running east and west—although on some of the latter are found the steepest grades in the city—varying from six to thirteen per cent. These occur on streets crossing Main Street, and in the central business portion of the city.

Notwithstanding these steep gradients, the loads actually hauled over them every day are very heavy and the wagon tires generally much below the proper width. The city ordinance passed last year requires a three-inch width of tire for loads up to 3,000 pounds, and a four-inch tire for loads not over 6,000 pounds. As a matter of fact, hewever, loads of 7,000 pounds are commonly hauled on wagons with two and three-quarter inch tires, and the ordinary two-horse wagons, carrying loads of 3,000 to 4,000 pounds, have tires usually only two inches wide.

The heaviest load of which I have information was hauled recently, being a piece of machinery for the Cable Railway Company, which weighed 22,400 pounds, and was hauled by eight horses on a wagon with three and three-quarter inch tires. It is estimated that 13,400 pounds of this load was on the rear wheels.

In the lower town the natural soil is a fine, light sand, which becomes saturated with water during flood stages of the river and in which there has been deposited, in the artificial process of filling up, a top layer of clay and debris ranging from one to three feet thick.

The widths of streets vary from fifty to ninety-nine feet, a majority of the

principal streets being sixty feet wide. A general law of the city makes the roadway three-fifths of the total width.

Street railroad tracks are usually of four feet gauge, laid four and one-half feet apart. The lines are as a rule, double track on business streets.

The rock found in and about the city is a common limestone—most of it very soft; there are, however, some ledges of hard blue limestone, and one of dark flint-rock. At Argentine, about four miles out of town, and at Edwardsville, are found considerable deposits of limestone in ledges, varying in quality from soft calcareous to firm granular rock containing a large percentage of silica.

The work of paving the streets of Kansas City may be said to have begun, properly speaking, in the spring of 1882. At that date there were ninety-three miles of streets within the corporate limits of the city, of which fifteen miles had been Macadamized, the remainder being simply dirt roads. This work was done at intervals during the preceding ten or fifteen years under substantially the Telford-MacAdam specifications, and consisted of a layer of stones eight inches deep roughly set on edge, with four inches of stones broken to two and one-half inches diameter spread on top. The sub-grade was not rolled or compacted in any way. The larger stones used were very irregular in size and shape, and were not carefully placed. The top layer was put on in one course without rolling or binding in any way, and the quality of the stone used was generally of the more accessible and softer kind.

This class of work was mainly confined to the principal thoroughfares and is very unsatisfactory in its results. The stone wears away rapidly under the heavy street traffic, or becomes pounded down into the soft clay underneath, so that in dry weather the surface is very rough and uneven, and in wet weather the streets are almost impassable. Repairs have consisted of simply dumping wagon loads of broken stones into the worst holes and ruts and leaving it to be compacted by the travel on the street.

The first cost of this kind of street improvement was about fifty-seven cents per square yard. The cost to the city at large every year has averaged, I estimate, $1,000 per mile, although, probably, on some of the main traffic streets, the cost has been much above the average. Correct figures are not obtainable.

The stone for repairs is furnished without first cost, and the breaking is done by the work-house prisoners at a nominal expense.

In the spring of 1882 all of the principal streets were in very bad condition. The first contract for paving any street otherwise than by Macadamizing was let February, 1880, and included that part of Fifth Street between Broadway and Bluff Street. The specifications called for Medina (N. Y.) sandstone, cut after the Belgian form, six to seven inches deep, laid on a six inch bed of coarse sand, and with the joints between the blocks filled with asphalt paving cement. The cost was $3.50 per square yard. The work was not, however, completed until January, 1883. Meanwhile the second contract had been let, in February, 1882, for paving that portion of Wyandotte Street between Fifth Street and Ninth Street with round white cedar blocks, six inches long, set on one-inch boards, bedded

on three inches of sand. The spaces between were rammed full of sand, and a coating of asphalt paving cement spread over the surface. The cost was $1.75 per square yard.

These two contracts were not preceded by any special public consideration of the subject generally, and were, as to kind, mainly the result of accident and individual interests.

The question of the proper kind of pavements for our streets came up in June, 1882, prominently in connection with the improvement of Sixth Street, between Delaware and Bluff Street. This street had just been regraded so as to form a new avenue for travel to and from West Kansas, and with the expectation, which has since been realized, that it would immediately become a main thoroughfare and leading business street.

Under the law of this city, the paving of any street cannot be done by the authorities until the owners of property along the street, representing the majority of the front feet (exclusive of non-resident ownership) shall formally petition the common council to have the work done. It is also necessary that the property-owners shall specify substantially what kind of pavement they want laid down. The entire cost of the work is assessed against the property fronting on the street.

The property-owners on Sixth Street selected a committee to consider the various kinds of pavements suggested, and finally decided, upon my recommendation, to put down a substantial concrete base nine inches thick, with a cedar block seven inches long for a wearing surface. The specifications which I prepared at this time have governed, without material change, all work of this character done since then, excepting that the thickness of the concrete foundation is made on some streets six inches, instead of nine, as on Sixth Street, and six-inch blocks have been put down on some of the streets instead of seven. The leading features of the cedar block pavement, put down in this city, are as follows:

The roadway is excavated to proper depth, and made to conform to the shape to be given to the finished surface of the pavement. Care is taken to secure, as far as possible, uniform density of the sub-grade, by the use of a two-ton roller, (the only one available), and by filling in soft spots with broken stone and ramming them down into the soil.

On this sub-grade is placed a layer of hydraulic cement concrete nine inches thick on some streets, and six inches thick on others, depending principally on the character of the formation, location, and character of the street, whether it is a business thoroughfare, or a street in a residence part of the city. In an exceptional instance the depth of the foundation has been reduced to four and one-half inches by the property-owners, although, generally, the popular disposition has been in favor of the nine-inch base on streets of all kinds.

The concrete is composed of five parts by measure, of clean limestone, broken to go through a two and one-half inch ring, and two parts of clean coarse river sand, with one part of approved hydraulic cement. The sand and cement are thoroughly mixed dry, and then wet, and the mortar spread over the stones, which

are spread out in a layer in a box. The mass is then thoroughly mixed together and loaded out into a wheelbarrow, deposited in place, and rammed until the mortar flushes to the surface. The cement is required to stand thirty-five pounds tensile strain per square inch after twenty-four hours. The brands used have been "Fort Scott," Kas., "Milwaukee," and various kinds of Louisville. On the surface of the concrete, which is made to conform to surface of street, a layer of sand is spread about one-half inch deep, or sufficient to fill up all the minor irregularities of the surface of the concrete, and make an even bearing for the blocks. The blocks are of white cedar, varying from four to eight inches in diameter, and are required to be cut from good sound live timber. They are usually seven inches long when set on nine inches of concrete, and six inches on the lighter base. They are sawn with parallel ends by gang saws, and are laid up as close together as practicable in the street. The interstices between the blocks are twice swept full of gravel, which ranges in size from one-quarter to three-quarters of an inch, and rammed down with round-pointed iron rods. After the first ramming, the surface of the block is made smooth and uniform wherever it may be uneven by going over it with a light paving rammer.

Asphalt paving cement, composed of coal-tar, distilled at 300° to 400°, and mixed with fifteen percent of mineral asphalt, is poured hot over the pavement, filling up all the minor interstices between the blocks. A thin coating of sand is then thrown over the surface before the asphalt dries.

The first prices at which this kind of pavement was let were $3.25 and $2.96 per square yard, for parts of Fifth and Sixth Streets, in the spring of 1882. This was for seven inch blocks on nine-inch concrete. Since then the cost of this work has been constantly decreasing with each successive letting. The last work contracted for was let at $2.44, and the average price paid during the season was $2.56. For six-inch blocks on six-inch concrete, the price has varied from $2.32 on the first, to $2.18 on the last contract let.

The ordinary wages for common labor has been $1.75 per day. The materials used cost about as follows: Seven-inch cedar blocks, eighty to eighty-five cents per square yard measured in the street, and six-inch blocks about seventeen cents less. For gravel, ten to twelve cents per square yard of pavement with seven-inch blocks. For asphalt paving cement, fifteen to eighteen cents per yard. The broken stone for concrete costs $1 per cubic yard, and sand about the same. Cement varies from $1 to $1.25 per barrel of about 260 pounds. The concrete in place is worth about $3.50 to $3.75 per square yard. One block of seven-inch cedar block pavement has been laid during this year on one-inch boards with four inches of sand underneath at a cost of $1.95 per square yard.

Observations of the wear of cedar block pavement with concrete base show a good, smooth surface and very uniform wear.

Blocks taken up at the intersection af Fifth and Main Streets, in the center of the business part of city, eighteen months after laying, showed a very regular wear of one-quarter to three-eighths of an inch. Blocks taken up for water and gas connections on the most crowded parts of Fifth and Sixth Streets, where

nearly all the heavy loads are confined to the ten and one-half foot strip of paving between the railroad track and the curb, show a wear of about three-eights of an inch in nearly two years.

There has been no repairing done on these streets, and there is no indication that any will be for some time. At all places where the pavement has been broken into, the concrete is found to be hard and compact. In one instance it was carrying the traffic of the street over a hole four feet across underneath. The bituminous concrete between the blocks has always appeared well formed, with but few voids occasionally near the bottom. The blocks are so thoroughly fastened together that sections of four to six square feet have been taken up without breaking. No swelling of the blocks and raising from the concrete has been observed. In very cold dry weather fine cracks appear running nearly directly across the surface of the pavement. They usually occur on steep grades and open from one to one and one-half inches if the extreme low temperature continues, but close up again with warmer weather.

The first stone pavement laid after the Medina stone, on a part of Fifth Street, was on a part of Bluff Street. Owing to the exceptional location of this street, no petition from adjoining property-owners could be expected, and in view of the public importance of this thoroughfare an appropriation of $15,000 was made out of the general fund to pave it. It was expected that a sufficient thickness of the old MacAdam metal would be found to form a good foundation on most of this street, considering the tons of broken stone that had been hauled there during the previous years. In the absence of this the specifications called for a six inch concrete foundation, which, in fact, was found necessary over the whole street. On this was placed a layer of two to four inches of sand. Rectangular blocks of the Argentine, or other good quality of native stone, was used for the wearing surface on my recommendation. The work could not be put under contract until late in the season, and consequently the eastern half, below Sixth Street, was prosecuted during the worst kind of winter weather—with the subgrade constantly wet from side-hill drainage, rains and snow, and was dug up to considerable extent by the gas company.

New quarries were opened and much of the stone laid in frosty condition on frozen sand; only the most urgent public necessity could justify doing the work under these circumstances. The western half remained unpaved and in nearly impassable condition, until early in the following spring. Meanwhile the large volume of the heaviest traffic in the city was turned on to the new pavement. This pavement cost $2.95 per square yard, or about $2.35 exclusive of the concrete base.

A line of three-inch agricultural tile drain pipe was laid along each side of the street near the gutters—that on the east side being for the purpose of draining the wet soil at the base of the hill, along which it runs—and that on the west side for sub-drainage and protection of retaining-wall.

Observations of the wear of this paving show numerous minor depressions of the surface, principally along the east side, and are due partly to unequal

wear of the blocks, and partly to settling of some of the numerous excavations made and imperfectly refilled, just in advance of the pavement. The principal objection to this stone is the variations in quality and consequent unequal wear. Although the effort was made to secure, by inspection at the quarries and on the ground, uniformity in quality, still the result shows that this has not been fully attained, and is, I think, impracticable for large quantities under the existing conditions. A large proportion of the stones indicate good wearing qualities, and will probably last for fifteen years, but the more rapid wear of the softer kinds makes a rough pavement and brings undue wear upon the others.

This material is extensively used by the street railroad companies for paving between their tracks, without any special selection as to quality used or shape of blocks, and without adequate foundation or care in laying.

A very superior quality of sandstone block pavement has been laid during the past season on Union Avenue. The stone is a firm, small-grained, metamorphic sandstone of pinkish color, quarried in the foot-hills of the Rocky Mountains, in Boulder County, Col. It lies in well defined and fully separated ledges varying in thickness from one inch to several feet. The ledges selected for paving stones are from three to four and a half inches thick, and the blocks are cut out from eight to twelve inches long and six inches wide. The Union Avenue pavement has a concrete base of nine inches, with two inches of sand on top, and has the joints swept full of sand. The side joints are smooth, corresponding to the natural top and bottom beds of the stone in place, and the ends re-cut to lay to one-half inch joint.

This pavement cost $5.38 per square yard, or about $4.25 exclusive of concrete. The stone costs on cars here, about $2.50 per square yard, measured as laid. Portions of this pavement that has been under heavy and continuous traffic since first put down, indicate excellent wearing qualities. A part of Mulberry Street, West Kansas, has also been paved with this stone, on a nine-inch bed of sand, with a well prepared sub-grade. East Ninth Street, from Main to Grand Avenue, is now being paved with the same material, on six inches of concrete. The grades on these two blocks are eight and thirteen per cent.

Walnut street from Twelfth to Twentieth, about 4,600 feet, was macadamized last year. The stone was carefully selected for hardness, and was broken to size from three and one-half inches to two inches. They were spread on in three layers, one of five and two of four inches each, making a thickness when rolled of thirteen inches at centre of roadway, and eight inches at gutters. The top layer is of very hard flinty rock and was mixed with a binding material of sand and clay; the only roller available was an old one weighing about 4,000 pounds and was altogether too light to compact the metal. There was considerable travel over this street while the work was in progress, forming well-defined ruts in the loose stones along the center. The street has been carrying a large and heavy traffic for a year now, and is in very good condition, although it has had no repairs at all. This work cost sixty-three cents per square yard.

A portion of Hickory Street, in West Kansas, about half a mile long, was paved under the Telford-MacAdam specifications, at a cost of seventy-eight cents per square yard. It has had no repairs since completed, and has been carrying a very large traffic with reasonably satisfactory results. The character of the pavement on these two streets, was due, in the case of Walnut Street, to the strong preference of a few active property-owners; and in the case of Hickory Street to the impracticability of getting a majority of the property-owners to agree upon any better kind.

A large amount of good macadam pavement might properly be put down on certain streets, provided the city had a heavy steam roller to use in construction, and, in addition, a well organized and equipped force to make repairs. Under present circumstances I think it is bad policy to improve streets—especially business streets like these—in this way.

All the materials used and the execution of the work is under constant supervision—one, and frequently two, inspectors being assigned to each piece of work. The whole work is under the immediate charge of the Superintendents of Construction, and care is taken to insure good workmanship and a substantial compliance with the specifications throughout.

The drainage system of the street surface is from the center each way to the gutters, and along the gutters to sewer inlets at nearest street corners.

The standard form for paved streets makes the pavement at the center of the street level with the curbs, and thence sloping down on curved lines to eight inches below this level at the curb line, excepting in the case of macadam streets, which are designed to have twelve inches fall to the gutter. Considerable variation, however, is found to be necessary on account of the existence of single or double lines of street railway tracks along the center of the roadway, and frequently on account of streets where the old established grade varies from "level across" to three feet higher on one side of the roadway then on the other. Some modifications are advisable, too, in cases of steep longitudinal grades, but the general purpose has been not to make the cross-slope greater than eight inches in eighteen feet, and to make the gutter not less than six nor more than twelve inches deep.

Starting in tne spring of 1882 with seventy-eight miles of dirt streets out of the total of ninety-three miles in the city, and the remaining fifteen miles of old Telford-MacAdamized streets which included all of the business streets, the work of paving done since then has been at follows:

	Miles paved.	Cost.
In 1882.	0.98	$ 31.137
In 1883.	2.63	132.755
In 1884.	9.03	442.167
Total	12.64	$606.059

We have taken up five and two-thirds miles of old MacAdam pavements and replaced them with stone or wood blocks.

	Miles.
There are now in the city, of old MacAdam pavement, about	9.3
Of new MacAdam	1.3
Of cedar blocks on concrete foundation	9.6
Of stone blocks on plank foundation	0.64
Of stone blocks on concrete foundation	0.7
Of cedar blocks on sand foundation	0.4
Total paved streets	21.94

Most of this work has been done on streets in the business part of the city. The work projected for next year will probably increase our mileage of paved streets by eight or ten miles, although as the initiative of this matter must in every case be taken by the owners of property on the streets, it is difficult to predict what the extent of work will be.

Excavations in newly paved streets have been carefully attended to with the object of preventing this prolific source of destruction to pavements. Permits are only given to parties who have obtained a proper license after filing a bond of $1,000 and depositing $25 in cash with the city treasurer, subject to the order of the city engineer. The conditions I have required of all parties who desire to make excavations in paved streets for gas, water and sewer connections, provide that the trenches shall be refilled with small broken stones, mixed with only a moderate proportion of clay, put in and thoroughly rammed in twelve inch layers. The sides of the excavation at the top are sloped out and double the original thickness of concrete put in, and the blocks replaced in a workmanlike manner. A special inspector is employed for the purpose of securing good work. As a rule, this has been accomplished and the pavement restored to its original condition and without subsequent settlement. This is considered a very important matter, and the requirements are based upon the principle that no individual has the right to damage a street pavement if it is practicable to prevent it. The Water-Works Company and the Gas Company have a general right to dig up the streets without legal restrictions, which is essentially wrong in principle, but practically, in this city, these companies have usually manifested a disposition to comply with proper requirements.

The general law of the city requires that railroad companies shall pave the space between the rails of all tracks, and a space of eighteen inches on the outside of each rail in the same manner as the roadway outside of such tracks may be paved. Great difficulty has, however, been experienced in getting this work done right, and practically the paving done by the companies is of a very inferior kind.

A good deal of special argument has been made against the use of concrete on that portion of the street to be paved by the company, as impracticable, but I am of the opinion that it is not quite practicable to use the concrete foundation,

but that it is eminently desirable that it should be so done, and that the foundation for all the paving should be uniform on every part of the street.

Some modification of the present method of track construction is advisable along streets with a concrete base, and it would appear to be a good, sound principle of public policy that the track paving should be made to conform to the street work, rather than that a special and objectionable modification should be made to suit the interests of the railroad companies.

In conclusion, I would express my opinion that the use of the concrete base, which is a characteristic feature of street pavements in this city, is right and proper. It is the most essential feature of a good street pavement, and it is noteworthy that this foundation should meet with such popular approval, and that this new city should be the first in the country to start right in this vexed problem of street paving. The main part of the street pavement is down for all time, and the wearing surface may be renewed when worn out, or changed and improved, as may be hereafter deemed best, at comparatively small cost.

I venture the prediction that Kansas City will, if this plan is continued, waste less money and profit more by the experience of the world in this matter than any other city that can be named.

A NEW STREET CAR RAIL.

The owners of light vehicles, the street car companies, and the stranger within our gates will be glad to be informed that a tramway rail has been invented which not only admirably serves the purpose for which it is designed, but can be laid in such a way as to leave the street as smooth as though it was not there. A rail of this kind is now in almost general use in the principal cities of Great Britain, and is found to work admirably. Its cost is not greater than that of the very objectionable T rail now in use here; it can be laid in almost any kind of asphalt, macadam, or stone block pavement without wooden ties or stringers, and when once laid becomes almost permanent.

Leaving out altogether the damage done to vehicles, the question whether or not the beautiful streets of our city are to be ruined by these tramways is one which should be carefully considered. I remember very well the appearance of some of our streets when I left home last summer. On Pennsylvania Avenue the unsightly appearance of the cobble-stones and the paving adjacent to the rails made a disagreeable impression. In some places the concrete extended to the rails, and in other places stonework extended for a short distance, alternating with the concrete. In some places whole slabs of stone, four or five inches wide and four feet long, were placed next to the rails. There was no symmetry whatever in the whole track and it resembled altogether an immense patchwork. When repairs were made no attention seemed to have been paid to making the track even or level, and, in consequence, numerous hillocks of cobble stones were the result. On Seventh, Ninth, and F Streets these evils were increased

by the numerous ruts in the space between the tracks as well as along side the rails. These ruts were caused by wagons having a broader gauge than the tracks being compelled to make use of them for various reasons. I suppose these matters have not claimed the attention of the commissioners.

The tramways in Liverpool are the perfection of the system employed on this side of the water, and I will endeavor to give you a crude idea of their appearance and construction. The Liverpool lines as now laid are conclusive proof that when tramways are well designed and properly constructed there is not the slightest impediment even to the narrowest-wheeled vehicles. The formation of the proverbial rut is impossible with this tramway and after completion it presents a symmetrical and smooth surface of great durability. The grooved rail I have mentioned is best shown by the following illustration, and in connection with it I have drawn the wheel in use. The groove is about three-quarters of an inch wide and the flange is in the middle of the wheel:

FIG. 1.

The following figure represents a section of the foundation and the track as completed. It will be seen that the rail is flush with the granite blocks and the latter on a level with the surface of the paving of the street, which in Washington would be the concrete shown in the illustration:

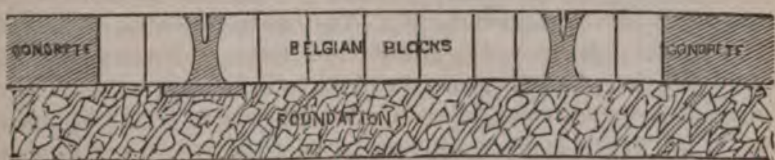

FIG. 2.

The bed or foundation consists of concrete mixed, and laid in the manner usually adopted for our street work, and formed to within about seven inches of the surface of the street. The surface of the concrete is carefully finished to the exact cross section of the paved roadway. This concrete consists of six parts of perfectly clean river or sea gravel, and eight of hard stones broken as angularly as possible, to one part of Portland cement.

The space between the rails and track and for eighteen inches on either side

of the roadway is paved with Belgian blocks. The sets are squared throughout, accurately gauged and laid in straight and properly bonded courses, and evenly bedded in concrete. The joints of the sets are filled with cement. These blocks resting on a firm foundation, there is no possibility of the settling of the roadway.

The cost of building a tramway of this kind is small in comparison with its great durability and the great blessing it would be to the public. If this tramway is introduced in America, and in Washington particularly, it will be a complete success and give entire satisfaction to the public.—*Correspondent National Republican.*

THE PROBLEM OF RAPID TRANSIT SOLVED (?)

Mr. John R. Abbe, an engineer of St. Louis, has proposed a scheme for rapid transit, which for ingenuity and magnitude exceeds any yet offered to the public. It is the result of two and one-half years' labor commenced while in Manchester, England, and finally concluded in St. Louis.

The first condition requisite for this great railway, according to Mr. Abbe is that the road-bed have no curves of less than 3,000 feet, and no grades of more than twenty-seven feet to the mile. This would in the construction of the road necessitate the removal of mountains and the filling up of valleys, but these are some of the obstacles that the capital required is expected to overcome. The reason for making the curves so gradual and the grades so slight is, as may be easily conceived, on account of the tremendous rate of speed at which this ideal express train will travel. It is also necessitated in part by the width of the track, which will be, when constructed, nine feet between the outer rails.

These rails will, when laid, be of ordinary pattern, though heavier than the ordinary rail, or with a face of about four and a half inches. Midway between the outer rails, will rest another of the same weight, but different in pattern, being angled on both sides from the top. The reason for having this rail angled is that on either side of it may run friction rollers connected with the car, which will thus be guarded against the likelihood of a leap into space when it is progressing at the rate of three miles a minute between the two great metropolitan cities of the United States. All three of these rails will be seven inches high, with a base of seven and one-half inches resting on ties of metal. The entire road-bed, when laid out, will be fenced in from communication with the world and all cities, towns, streets, country-roads, and cattle will have to keep out of the path lest they should delay the progress of the ideal express.

The road-bed having been laid out, the ties and rails placed in position, and a glass roof placed over the whole. Mr. Abbe presented a plan of the engine and cars which are expected to overcome the forces of nature, or, rather, utilize her power in overcoming the obstacles which she has placed in the way of rapid travel. The care which takes but a passive part in the performance, is iron-

plated. The first train may, in honor of the event, be silver-plated, but the general idea is that, for the preservation of the cars, they be covered with sheets of metal or be constructed of metal throughout. The general shape of the conveyance will be that of a cigar.

For the engine which is to travel over the rails at such a tremendous rate of speed, Mr. Abbe has devised several improvements in cylinders, valves, seats, etc., which, as they are of value to him and he hopes to have them patented some day, are not described here. The general appearance of the engine is that of three huge wheels preceded by a sloping frame and followed by a tank, from the top of which rises a short smoke-stack. The tank contains the water which is scooped up in transit from huge troughs between the rails. Through the tank to the smoke-stack runs a pipe which, coming from the fire within the boiler, heats the water in advance. Beneath this tank is a center-pin truck, with two pair of weels, a companion to which supports the head of the locomotive. Upon these trucks rests the huge framework, which is bowed like a bridge and whose oscillations, according to Mr. Abbe, will therefore be vertical, and not horizontal. The driving-wheels which propel this piece of mechanism are to be three in number, resting upon three rails. The center wheels runs quite ahead of the other two, but the pistons which operate it work from the other side of the same steam-chests that furnish the power that propels them. The driving-wheels may be flanged or not, according to the desire of the passengers. The engine will be held upon the rails by the action of small wheels running horizontally or at angles of 45° on the sides of the middle rail. The diameter of the truck-wheels will be nine feet. The three driving-wheels will be twenty-four feet in diameter, giving a piston speed of 1,470 feet per minute to make the three miles which Mr. Abbe expects his machine to cover in that time. "The shaft that has the two wheels," according to Mr. Abbe, "has cranks on the inside of journals, the center of pin corresponding with the center of engines. Then when engines are placed midway between the single and double drivers allows the double pair of drivers to govern the machine when running, while the single wheel, running on the center rail, is allowed an easy motion in conformity to the engines."

The engineer who manipulates rhe reverse and the cut-off for the ideal express will occupy a position of some prominence, his domicile being placed between two of the big driving-wheels and behind the third. The fireman and engineer will be widely separated, the fire-boxes being close to the ground and extending on either side of the forward driving-wheel. Thus the engineer will have to be his own lookout. The peculiar advantages of the position given to the cab are said to be the vertical control over the engine and the superior view of the track.

The engines will have cylinders 30x42 inches in diameter and the open portions of the skeleton frames will be filled in with a non-conducting substance of asbestos and plaster-of-Paris, which will retain the heat and prevent condensation in the cylinders. The boiler will be placed on the lower frame under the crank shafts. The coal bunkers are in the extreme forward end of the machine

just ahead of the fire-boxes. The weight of the boiler is evenly distributed, and by placing the heavy parts of the machine so near the rail a swinging motion is prevented when the engines are in operation.

In conclusion Mr. Abbe states that 300 pounds pressure will be necessary in the boiler. Now these important questions, he says, arise: Can such piston-speed be used? Can packing be made which will stand such friction and metal bearings which will keep cool? Can steam be made fast enough with the boiler in such a position? Can men be found to fire such a machine or run it? Will people ride at such a rate of speed? These, of course, are minor points, however, and easily overcome. The main questions have been solved in this article and rapid transit is now an assured fact. It is to be hoped that Mr. Abbe will hasten to enter into a contract with the projector of the tunnel between England and America under the Atlantic, so that his ideal express may in the hereafter be utilized, not only for trans-continental but for inter-continental travel.—*Globe-Democrat.*

STAMPED RAILWAY WHEELS.

The following account of the manufacture of railway wheels by stamping at the Blast Furnace, Forge and Steel Works, St. Chamond, is from *Revue Generale des Chemins de Fer*, and was translated in the abstracts of the British Institution of Civil Engineers: "The wheel centre is constructed in three operations—the formation of the rough piece, the rolling into shape and to the diameter, and the finishing off. The processes are a little different for working in iron and in steel. The description applies to a wheel center of the Western Railway having an undulated web of about three feet in diameter and weighing 495 pounds. A wrought-iron pile is made up of six layers of bars, eight inches by four wide, cut to a circle twenty inches in diameter, placed between two flat rings of iron, one above and one below the six layers, keeping them in and binding them. Three rings of one and one-half inch square iron, seven or eight inches in diameter, are piled upon the layers as materials for the nave. After the hammering for the first heat, the slab is inverted and three more rings are placed on the other side for the other portion of the nave, and for the second heat. With two more heats, making four heats in all and five or six blows of the hammer in each heat, the forging is completed. The central opening is punched out in the operation of stamping. For the manufacture of steel centers a very mild steel is used, having a tensile strength of from twenty-five tons to thirty tons per square inch, and an extensibility of twenty per cent. A special ingot weighs, for one of the Western wheels, 530 pounds. The work is done in two heats. The ingot is heated, in the course of an hour or an hour and a half, to a white-yellow. It is placed for hammering in the position it occupied in the mold, and any blown holes that may be present in the bloom are likely to be removed in piercing for the nave. Each hammering requires from five to ten minutes; the second heat

only requires twenty minutes. The rim and the web are rolled to form in one heat by rollers similar to those employed for rolling tires. In the same heat the center is finished under a fifteen-ton hammer. Steel centers are annealed by being raised to a cherry-red heat and cooled slowly, covered by iron plates. Centers of steel and of iron have been tested for strength by the falling of a weight of seven tons upon the nave, the center being supported horizontally at the rim. The steel center resisted without fracture 210 blows of the hammer falling from eight to eighteen inches. The nave was depressed four inches. An iron wheel broke with 150 blows on a fall of from eight to twelve inches.

WASHINGTON MONUMENT COMPLETED.

The long expected completion of the Washington Monument obelisk was accomplished on December 6th by the setting in place of a marble cap stone and its pyramidal apex of aluminum. The ceremonies were few and simple, an elaborate celebration of the event being reserved for Washington's birthday. Shortly after 2 o'clock Col. Thos. L. Casey, Government Engineer-in-charge, and his assistants, Capt. Davis, United States Army, and Bernard R. Green, civil engineer, together with Master Mechanic McLaughlin and several workmen, standing on a narrow platform built around the stopped marble roof near the summit, proceeded to set the capstone weighing 3,300 pounds, which was suspended from a quadropod of heavy joists supported by the platform and towering forty feet above them. As soon as the capstone was set, the American flag was unfurled overhead and a salute of twenty-one guns fired by a battery in the White House lot far below, the sound of cheers also came up faintly from a crowd of spectators gathered around the base of the monument, while a number of invited guests were on the 500 foot platform, and on the interior of the foot of the monument at that level spontaneously struck up "The Star Spangled Banner" and other patriotic songs. A steady downpour of rain had given place a little while previously to a brisk gale of wind which, at this elevation, was blowing about fifty-five miles an hour, and very few invited guests cared to avail themselves of the privileges of climbing the nearly perpendicular ladder from the 500 foot platform to the dizzy height of 533 feet from which three or four journalists and a half dozen other adventurers climbed and witnessed the setting of the capstone, and subsequently ascended to its pinnacle.

Meanwhile the Washington Monument Society, represented by Dr. Joseph M. Toner, Hon. Horatio King, Gen. William McKee Dunn, Dr. Daniel B. Clark, and T. L. Harvey, Secretary, held a meeting on the elevated platform at a height of eight feet, and when the artillery firing announced the setting of the capstone, adopted a resolution offered by Gen. Dunn congratulating the American people on the completion of this enduring monument of our nation's gratitude to the father of his country.

Among those present to-day at the completion of the structure was one of

the master mechanics who laid the corner-stone of this monument more than thirty-six years ago, and the old watchman of the monument who has been continuously employed in that capacity during nearly the whole intervening period. The flag over the monument floated to-day from the flagstaff-top, which is exactly 600 feet from the ground, thus displaying the American colors at the greatest height ever known in the world. The monument itself, with its height of 550 feet, far overtops every other structure of human hands. The aluminum apex of the monument is engraved with inscriptions, as follows: On one face

> "Chief Engineer and Architect, Thos. Lincoln Casey, Colonel Corps of Engineers. Assistants Geo. W. Davis, Fourteenth United States Infantry; Bernard R. Green, Civil Engineer; Master Mechanic P. H. McLaughlin."

On another:

> "Corner stone laid on the bed of the foundation July 4, 1848. The first stone at a height of 152 feet, laid August 7, 1880. Capstone set December 6, 1884."

On a third:

> "Joint commission at the setting of the capstone, Chester A. Arthur, W. W. Corcoran, and Chairman M. E. Bell, Edward Clark, John Newton, Act of August 2, 1876."

And on the fourth face the words:

> "Laus Deo."

The capstone is a cuneiform keystone four feet five and three-quarter inches on the outer faces in height, with a shoulder on each side of seven inches to tie the ashler face of the pyramidal cap; below this shoulder the stone is ten and a half inches, making the total length from top to base five feet two and a half inches. The stone at the base is three feet nineteen-seventeenth inches square, and at the cap where the aluminum tip is to be placed, the diameter is exactly five inches.

The aluminum tip is something new in monumental architecture, and its use is for two purposes. It is freer from oxidation than any other substance that could be used, and it is of exceptional value as a conductor of electricity, serving, in this case, as the tip of both monument and the lightning-rod. It will be secured in its place by a wrought copper rod, leading down through the center of the capstone, and below will connect with each of the four columns that form the elevator frame in the main shaft. At the base of the monument, these leaders will be conducted to the well beneath the center of the foundation, thus forming the most perfect electrical conductor known to science.

The capstone was set by the following means:

Beginning a few feet above the main shaft, on each of the four sides of the pyramid, four heavy joists are placed, and on these, thirty-three feet above, is built a platform extending around the cap. Extending up from this platform are four joists, one at each corner of the structure, which meet forty feet above and support a tackle with which the remaining stones are handled. To the point where the platform is built all the stones of the pyramid were handled with the mast and boom that extended from the interior framework, but as the cone narrowed, the spar was removed and the outside frame built. Before this, however, all the remaining stones were hoisted to the platform and handled from there. When the capstone is set this afternoon and the tip placed in position and fastened to the copper rods below, the upper joists will be removed and lowered by the men, and as the platform and its supporting-frame is taken away and lowered, the remaining men will work from a temporary platform hung from skids or joists projecting from the window, which has been cut in the east face of the last course below the cap. This window is three feet long and two feet wide, and after the last timber has been lowered and the last man has entered the pyramid the hole will be closed by a stone, which accurately fits, and cemented in place. The lower platform and the guard-netting at the 500-foot level will be removed through the hole at the base of the pyramid, which was left to pass the upper stones outside from the elevator. When this is done the stones belonging there will be set and the whole structure from foundation to the aluminum tip will present an unbroken appearance. The narrow windows in each face of the pyramid, which are four feet above the 500-foot landing, will be fitted with heavy marble shutters, which are to be worked by ingenious machinery inside. These windows, which seem like tiny streaks from the ground, are each three feet long and eighteen inches high, and are eight in number, two on each face, giving a perfect view of the surroundings.

The corner-stone of the monument was laid with imposing ceremonies July 4, 1848, and the work for several years was paid for with money derived from popular subscriptions. The source, however, soon failed, and after about $200,000 had been expended the work ceased, and during the years that elapsed from 1852 until 1859 the unfinished shaft (which resembled more the whitewashed chimney of a huge factory) was this nation's disgrace. Finally, on Independence day of the Centennial year, Senator Sherman presented a resolution declaring it to be the sense of Congress that the monument should be completed. The resolution and the necessary appropriation to begin the work anew was passed by both houses unanimously, and since then the work has progressed steadily.

In 1876 the monument had reached the height of 152 feet above the foundation, and about $260,000 had been expended on its construction; $900,000 has been expended under appropriations of Congress. The corner-stone, which was cut from the same ledge of marble (near Cockeyeville, Md.), from which the marble of the shaft has been taken, weighed a little more than twelve tons, and was laid at the north-east corner of the foundation.

Very soon after the appropriation of 1876 became available, Colonel (then lieutenant colonel) Thomas Lincoln Casey, corps of engineers, U. S. A., was designated by President Grant, through Secretary of War McCrary, as the engineer officer to conduct the work, and Captain George W. Davis, 14th U. S. infantry, was ordered here from Texas and placed on special duty as an acting engineer officer, as assistant for the monument construction.

The first work done was in 1877, when shafts were sunk at different points about the monolith and borings made to find the character of the strata below the foundation. It had already been ascertained that the original foundation extended only five feet below the surrounding earth surface, while fourteen feet reached above to the floor of the shaft. The examinations showed that below the old foundation was a series of layers of yellow and blue clay on a rock strata, sloping away to the original bed of the adjoining Potomac, and that these beds of clay were thickly strewn with huge boulders of the ice-period. The clay taken out was tested for compressibility, but the examinations and tests showed that, to sustain the huge structure of over 81,000 tons, the foundation should rest upon the bedrock, still fifteen feet below. These examinations and the studies of the subject made by Captain Davis continued until 1878, when finally the plan of building a new foundation beneath the old one was decided upon, to the astonishment of engineers all over the civilized world. How such a thing could be done was the wonder until Colonel Casey and Captain Davis practically demonstrated it by accomplishing the fact.

The old foundation was so ridiculously shallow and narrow in base that the addition of the weight necessary to carry out the design of height would have sunk the structure into the ground, much like thrusting a cane into moist earth, or, more likely, have toppled it over toward the adjacent Potomac flats. A new and wide foundation was built under the old one and resting on the bedrock beneath. The magnitude of this before unheard-of feat of engineering was so great that home and foreign civil engineers visited the work to see for themselves that it was actually being done. The complete work of the sub-foundation is one of the greatest feats of engineering known in the world.

Meantime, while the foundation examination had progressed, means had been found to reach and examine the top which was left unfinished before Congress took action. The three upper courses of stone, each one two feet high, were found to be so damaged by the action of frost, and perhaps lightning, that they were removed before the work on top was resumed at the exact height of 150 feet.

September 11, 1878, an inspector of the proposed work and Mr. P. H. McLaughlin reported at the monument grounds, and were followed next day by a small gang of carpenters, of which Mr. McLaughlin was then the foreman, who began the erection of the necessary buildings. The first superintendent, who reported in the same month, was Mr. Navarre, and on his resignation in 1879 Mr. McLaughlin was promoted from master carpenter to succeed him.

August 7, 1880, the first stone above 150 feet from the foundation was laid, and to this date Mr. McLaughlin has superintended the whole of the work.

Since the commencement of work on this monument the States cf California, Oregon, Minnesota, Kansas, Nevada, Nebraska, and Colorado have been admitted into the Union, we have chronicled the history of nine political administrations, witnessed the birth and death of political parties, and passed through a terrible civil war and four financial strains, and established the best banking system in the world. The great republic in the meantime has grown from 23,000,000 to 55,000,000 people, and in material wealth from $7,400,000,000, or $320 per inhabitant, to $57,000,000,000, or about $1,000 per inhabitant. When the National Monument was begun Great Britain possessed five times the wealth owned by the United States, and while the wealth of the former country has only doubled within the past four decades, that of the latter has increased twelvefold. As to the constituent factors of American progress in their aggregate in the four decades they are sufficient to buy up the whole Austrian Empire several times over, or pay for the aggregate value of the "effete" monarchies of Italy, Holland, and Belgium almost three times over during that period. Our tilled acreage has increased from 50,000,000 to 170,000,000 acres, the crops have increased in value from $415,000,000 to $2,500,000,000, and the cattle have increased in value from $380,000,000 to $18,400,000,000. Our imports have increased from $178,-000,000 to $668,000.000, and our exports from $152,000,000 to $836,000,000.

The work is by no means completed now, for it will take many months, and perhaps several years, to complete the pedestal and finish up the surroundings.

The joint commission in charge of the monument has recently submitted to Congress a report showing its progress during the past year. The report shows the weight of the monument is 81,120 tons, and it has cost $1,187,710, of which Congress appropriated $887,710. In relation to the completion of the monument the engineer in charge of the work submitted a report with that of the commission. He says: "Two methods of treating thc terrace at the foot of the shaft have been suggested. One method proposes to erect a retaining wall of the most beautiful marble around the terrace, which wall is to be surmounted with marble balustrade. At the centre of each face is to be set off, broad double stairs extending from the general level of the esplanade, which is to be paved with marble tiles of approved patterns. The other method of finish proposed, is to fill earth about the present terrace, and extend this filling as far from the monument as to fade the slopes of the embankment gradually into the surrounding surfaces, and this is to be done with so much skill as to give the mound an appearance as far from artificial as possible. This mound is then to be planted with trees and shrubs, and paths are to be laid out. A pavement is to be put around the foot of the mound, far enough to prevent storm waters from washing out the filling. If the marble wall is decided upon, an appropriation of $612,300 is asked to complete the entire work. If the second proposition is adopted but $166,800 is desired. The joint commission favor the latter method.

The Congressional Commission to arrange for the dedication of the monu-

ment invites through the medium of the Associated Press all civil, military and naval organizations in the United States to attend the ceremonies, which will be held at the base of the monument on the 21st of February, 1885. Any organization accepting this invitation is requested to notify Lieutenant-General P. H. Sheridan, U. S. A., Marshal of the day, of the number of persons in such organization, whereupon he will assign it to proper position in the procession to be provided for by the commission. At a meeting of the commission recently the programme was decided upon. The morning is to be devoted by the Marshal of the day to the concentration of societies and troops on the ground. The ceremonies at the monument will begin precisely at 12 o'clock, Senator John Sherman, Chairman of the Congressional Commission, presiding. The programme will be as follows:

Music. Prayer by Rev. Mr. Sutor, of Christ Church, Alexandria, Va. Remarks by W. W. Corcoran, First Vice-President of the Washington Monument Society. Remarks by the engineers of the joint commission turning over the completed structure to the President of the United States. Acceptance by the President for the people of the United States and dedication to the memory of General George Washington. Music.

During the performance of music the procession will be formed and will proceed to the Capitol Grounds where it will be reviewed by the President of the United States.

The order of procession will be as follows:

Chief Marshal, with Chief of Staff and an aide from every State and Territory; military escort; General commanding; brigade of artillery; brigade of infantry; naval brigade; battalion of marines; chartered military organizations, taking precedence by the dates of their charters, and temporarily organized in regiments and brigades; civic procession; Congressional Commission; members and ex-members of the joint commission for the completion of the monument; engineers of the monuement and detail of workmen; the Washington Monument Society; the President of the United States and orator of the day; the President and Vice-President elect of the United States; ex-Presidcnts of the United States; Judges of the Supreme Court; Diplomatic Corps; Governors of States and their respective staffs, taking precedence in the order of admission of their States into the Union; Senate and House of Representatives; Commissioners of the District of Columbia; Society of the Cincinnati; Masonic fraterntty, with other organizations which officially contributed stores or money for the erection of the monument; citizens of States and Territories, with civic organizations from those States without partisan flags or emblems, each State taking precedence in order of admission into the Union; Fire Department of the District of Columbia and visiting firemen.

BOTANY.

VEGETABLE DISSEMINATION.

REV. L. J. TEMPLIN.

Whoever looks into the vegetable world for the first time with an intelligent eye and a thoughtful and inquiring mind will be forcibly struck with the manifestations of design that meet him on every hand. The wise adaptation of means to ends and the beautiful harmony that appears in all departments of organic nature naturally lead the unbiased mind to the inference that, behind and beneath all this order and harmony, originating, upholding and directing them, there is, and of necessity must be, an all comprehending intelligent power. Probably in all the realm of organic nature there is no more manifest exhibition of wise adaptation of means to the accomplishment of worthy purposes than is seen in the various methods employed for the dispersion and dissemination of the different species of plants. This field of research furnishes so many evidences of design, and so much of variety and excellence that it seems difficult if not impossible to shut out the conviction that some intelligent designer must have been employed in planning a scheme that has so many excellences to commend it to the enlightened judgment. To attribute all this to chance is to invest chance with the attributes and acts of the Deity, and simply changes the name of this great first cause. But in the sense in which this term is generally used the assumption is absurd, as, in that sense chance is nothing and consequently can do nothing. Turning our attention to the subject of the dissemination of plants, we find Nature employing various methods that are not confined to any particular order or class of plants. Considering a plant in its relation to the world at large as well as to its own species, its whole purpose in life seems to be to propagate its own species, and disseminate its progeny as extensively as possible under its surrounding conditions. The spreading of plants from the original locality is accomplished not only in a great variety of ways, but also with a great diversity of degrees of rapidity.

The method by which the offspring is carried the least distance from the parent plant, and, consequently, in which the dissemination is the slowest, seems to find illustrations in those cases in which the young plant starts as a sucker or offshoot directly from the base or collar of the parent plant. In this process adventitious buds are formed at or just beneath the surface of the ground which push up new stems into the air, and from the subterranean parts of these, new roots are sent out into the soil, thus enabling the young plant to draw its nourishment from soil and air independently of the parent plant and even to survive

the death and decay of that parent notwithstanding the vital union that previously existed between them. These in turn form buds and send up suckers, thus further extending the group till joining with other similar groups an extensive break or forest is formed.

Examples of this are exceedingly numerous. This mode is often illustrated by the peach, apple and basswood among trees; the elder, currant and gooseberry among shrubs, and the balm, rhubarb and various grasses among herbaceous plants. A similar or identical principle is involved in those cases in which not only the parts about the base of the plant, but all parts of the roots, even to their extremities, form buds and send up suckers, thus extending the area occupied by the plant much more rapidly than in the preceding case. Of this method the wild plum, murello cherry, and the blackberry and red-raspberry are well known examples. Resembling this method in appearance is the multiplication of plants and the consequent growth of them a short space from the parent plant, is that by means of the rhizoma or underground stem. Some plants send out these stems laterly at a greater or less depth below the surface of the ground. At frequent intervals, greater or less according to the species of plant, a node is formed from which roots are emitted and a stem is sent up to the surface where it forms a perfect, and, to all appearances, an independent plant. Not only does this rhizoma continue to extend, sending up its numerous stems, but from each of its nodes similar stems branch off, usually on both sides, which repeat the same phenomena as the original one. In this way these stems and plants are multiplied till the whole space occupied by this multiple plant becomes a regular net-work of stems and the plants become so crowded as to smother the later comers that are struggling to reach the light and air. A single plant of this nature will, in a comparatively short time, occupy all the ground for a considerable distance in all directions from the original plant. And if it be a perennial, this process will continue from year to year, and there is really no limit to its extension except such as may be presented by insurmountable obstacles that may bar its further progress. As examples of this mode of propagation and dispersion may be mentioned the Canada-thistle, Chufa, Bermuda-grass and couch or quitch-grass.

Tubers, as of the potato and artichoke, are only enlarged underground stems, full of buds that we call eyes. From them the plants of the next season are produced a little distance from the stalk of the parent plant, and so the young plants are gradually separated and dispersed. Similar in nature and manner of growth to the underground creeping plants are those that send their creeping stems on the surface of the soil, sending roots into the soil and stems into the air, and also other creeping stems in lateral directions on the surface. Of this class may be named the twin-flower, the partridge-berry, some species of mint and some of the creeping grasses.

Differing but little from this is the regular running plant that sends out a slender stem that grows to some length without node or leaf; a cluster of leaves is then formed, from the base of which roots enter the ground and thus a complete

plant is formed, while the runner continues its course forming other similar plants as it progresses.

The best illustrations of this mode of dissemination are the strawberry and the cinquefoil. Rising still higher, we find plants with an upright mode of growth, that bend over till their tips come in contact with the soil where they take root and form new plants. In this manner the species travels, making a few feet of progress each year. The hobble-bush and black raspberry are good examples of this mode.

Many trees and plants, when their branches are brought into contact, with moist soil, will take root and produce new plants at a considerable distance from the one to which they are attached. The grape and gooseberry are familiar examples; but nearly all kinds of vegetation will do likewise if the conditions are exactly favorable. Still another method of extending certain vegetable forms is by means of aërial roots that descend from the branches till they come in contact with the soil, which they enter and divide as other roots. The circulation is then reversed and the portion above ground becomes a true stem. The stems continuing to elongate, this process is repeated on all sides till a single tree with its multitude of trunks becomes a forest capable of sheltering an army of men. The Banian tree is the most noted illustration of this. A single tree of this species is known to cover a whole island of considerable extent.

So far we have considered the dispersion of plants only in cases where the young plant remains attached to its parent till it has taken root and become established and capable of existing as an independent plant, but in none of these cases could the offspring start in life at any great distance from the parent plant, from which it proceeded and of which for a time it formed a part, consequently their progress was but slow; at most amounting to but a few feet in a year, and in many cases requiring many years to advance but a very few feet.

But it is evident that it would have required interminable ages to extend any forms of vegetable life, from any center of dispersion, to the different parts of the earth by any of these methods.

Nature has therefore provided for the general dissemination, reproduction and perpetuation of the various species of vegetable forms through the agency of seeds. Seeds are embryonic plants, in which the germ of the future plant, accompanied by a sufficiency of plant-food to sustain it till it becomes able to secure its own nutriment from the soil and air, is wrapped in peculiar cerements and generally enclosed in a leathery, horny or woody covering or shell. These seeds may be carried "to earth's remotest bounds," and preserved for years, and in some cases probably for ages, and then, when placed under favorable conditions, germinate and grow, producing in all essentials an exact counterpart of the plant by which the seed was produced.

The various means to be employed for the dissemination of seeds so as to scatter as far and wide as possible the plants of different species, seems—I speak it reverently—to have received the most careful attention of the Author of nature.

Many seeds and nuts are not provided with any means to aid in their distribution, but this is often accomplished in some degree by the spread of the branches causing them to fall at a little distance from the root of the plant producing them. Nuts and acorns in falling frequently strike on branches and bound or glance off to a distance of some rods. And in falling to the ground they frequently strike on sticks, etc., and bound to a considerable distance, and should it be on a hill-side, they may go several rods before stopping.

Many plants and shrubs grow in a leaning or inclined position as if on purpose to reach out and drop their seeds as far as possible from their own roots.

Many grow entirely prostrate, sending out their stems on the surface of the ground, apparently for the same purpose. Scores of plants might be named in illustration of this fact. Some plants have their seed carpels so arranged as to give the appearance of having been made specially to retain instead of disperse the seeds they contain. Poppy, jimson, mullein and many others have the opening at the top as if to prevent the seeds from falling out. But in this we see a wise provision for the scattering of the seed, for if the openings were at the bottom instead of the top the seed as soon as ripe would all fall out around the stalk on which they grew making it impossible to thrive; but as arranged the seed can be thrown out only as the plant is shaken by the wind or other means, and so is scattered around to a considerable distance. The wind is thus seen to become an agent in the dispersion of seeds. The seeds of some trees are furnished with wings (samara) to enable them to float or sail on the air or be carried by the wind as they fall, so they reach the ground some distance from the trees on which they grew. Maple, ash, elm, tulip-tree, linden or basswood, and pine are thus furnished with winged seed. It is worthy of notice that all these are trees that grow to a considerable height so the seeds may sail to a good distance before reaching the ground.

In this connection notice may be taken of the honey-locust and coffee-tree, whose seeds grow in a broad, flat pod, generally with a spiral twist that sometimes causes them to sail off several rods from the parent tree. Every one is acquainted with different kinds of plants that have attached to their seed a tuft of woolly or hairy pappus or down by which they are carried long distances by the wind. It is impossible to assign any limits to the journeys some of these seeds with their buoyant attachments will sometimes travel. Some claim, and with reason, that during long continued storms they may be carried across the ocean and fall on distant continents.

Thistle, dandelion, fire or butter-weed, are well known examples. The seeds of the cottonwood (poplar) are enveloped in a cottony down that causes them to float about and scatter to great distances over the country. He that cannot see adaptation and design in all these arrangments is blind indeed. Other plants, instead of furnishing their seeds with wings and down to fly with and travel from place to place themselves, scatter their seeds by the way. Two or three species of plants grow in this prairie country, that when grown form large bunches and when broken off by the wind they go rolling and tumbling over

the fields and prairies as driven by the wind, veritable "tumbling-weeds," scattering not only their seeds, but often those of other plants that have become entangled in them. The rose of Jericho (Anastatica) that grows in the arid deserts of both Africa and Asia, when mature, rolls up in a ball, becomes detached from the ground and goes rolling before the wind till it reaches a moist spot, or there falls a slight sprinkling of rain, when it immediately unrolls, the pods open and the seeds fall out and germinate within eighteen hours, so that by the time the transient moisture has disappeared the young plant has taken root and is ready to grow in spite of the scorching sun and blasting winds of the desert. While a few plants thus travel and sow their own seeds, others stay at home and throw them so as to scatter them to various distances. Some geraniums when the pod bursts throw their seeds out by a little spring that is arranged in it for that purpose.

In the pods of beans the fiber is arranged at an oblique angle with the linear direction of the pod and when it becomes dry and bursts, this arrangment of the fiber causes the two halves of the pod to suddenly twist spirally, by which motion the seeds are thrown out to some distance. The castor-oil bean also has the habit of throwing its seeds out by a sudden springing of the material of the pod Almost every one has noticed how the parts of the pod of the touch-me-not (impatiens) will curl up with a sudden spring and scatter the seeds in all directions on being touched or shaken. The wild touch-me-not, or jewel-weed, acts in the same manner but with even still greater energy. In cyclanthera, the fruit of which is not symmetrical, one side being flat and the other round, when ripe suddenly explodes scattering its seeds on all sides.

In arcentholium, a relative of the mistletoe, and a parasite of the juniper, the seeds are thrown from one tree to another. The squirting cucumber, a well known plant of southern Europe, as it approaches maturity, becomes so gorged with fluid that when fully ripe it bursts near the place of attachment to the stem and throws its contents to a distance of several yards. The discharge is accompanied by a report as of a toy pistol. Persons venturing to touch one, or even passing near them are liable to be greeted with the contents of this vegetable pop-gun. Many other plants that project their seeds might be named, but these are sufficient for our purpose. Water is also an agent in the dispersion and dissemination of seeds. During heavy rains and floods nearly all kinds of seeds are liable to be carried down from the higher ground into the rivers and by them transported long distances. These eventually find a resting place in the sediment of some island, or low bottom land, and spring up and flourish luxuriantly. The currents of the ocean also become the means of transport for seeds that are adapted to floating. The cocoanut, whose corky shell so well adapts it to this mode of conveyance, has thus been carried to all the islands of the tropics.

In many cases animals are agents in the dispersion of the seeds of plants. Numerous species of trees and plants bear edible seeds and nuts that are gathered by various animals and birds as winter stores, some of which are lost or forgotten and so are left to grow the following year. Many kinds of fruit are eaten by

birds and animals and the seeds either dropped or, being indigestible, are voided with their droppings and spring up and grow, often at long distances from where they originated.

The seeds of a large number of plants are furnished on their outer surface with barbs or hooks by which they adhere to the coats of animals and are thus carried and scattered far and wide over the range of such animals. Some of these barbs and hooks are quite small as in the burdock, sand-bur, beggar-lice, Spanish-needle, etc. But in a few cases they are large and appear quite formidable. The seed pod of the common martynia of our gardens, when dry will sometimes fasten its long curved claws in the skin of an animal, when it is with difficulty that it can rid itself of this terrible "devil's claw."

But the most formidable production of this kind, probably, in the world is a product of South Africa called by botanists, Harpagophyton procumbens. The seeds of this plant are numerously branched, the branches being near an inch long and having numerous stout, sharp, recurved prickles. When once fastened on an animal it is exceedingly difficult to remove. It is said that lions sometimes in trying to remove it from their feet after stepping on it, get it fastened in their mouths and finding it impossible to remove it die a most miserable death.

And here we take leave of our subject, though numberless other examples might be given to illustrate the beautiful adaptation of means to the purpose of covering the globe with the various vegetable productions of the earth. In the presence of such wisdom and goodness let up learn humility and reverence.

Cañon City, Colorado, December, 1884.

PHILOSOPHY.

RELIGION AND THE DOCTRINE OF EVOLUTION.[1]

FREDERICK TEMPLE, D. D., BISHOP OF EXETER.

The regularity of nature is the first postulate of Science; but it requires the very slightest observation to show us that, along with this regularity, there exists a vast irregularity, which Science can only deal with by exclusion from its province. The world as we see it is full of changes; and these changes, when patiently and perseveringly examined, are found to be subject to invariable, or almost invariable, laws. But the things themselves which thus change are as multifarious as the changes which they undergo. They vary infinitely in quantity, in qualities, in arrangement throughout space, possibly in arrangement throughout time. Take a single substance such, say, as gold. How much gold

1 Abstracted from "The Relations between Religion and Science," by the Lord Bishop of Exeter.

there is in the whole universe, and where it is situated, we not only have no knowledge, but can hardly be said to be on the way to have knowledge. Why its qualities are what they are, and why it alone possesses all these qualities; how long it has existed, and how long it will continue to exist, these questions we are unable to answer. The existence of the many forms of matter, the properties of each form, the distribution of each: all this Science must in the last resort assume.

But I say in the last resort. For it is possible, and Science soon makes it evident that it is true, that some forms of matter grow out of other forms. There are endless combinations. And the growth of new out of old forms is of necessity a sequence, and falls under the law of invariability of sequences, and becomes the subject-matter of science. As in each separate case Science asserts each event of to-day to have followed by a law of invariable sequence on the events of yesterday; the earth has reached the precise point in its orbit now which was determined by the law of gravitation as applied to its motion at the point which it reached a moment ago; the weather of the present hour has come by meteorological laws out of the weather of the last hour; the crops and the flocks now found on the surface of the habitable earth are the necessary outcome of preceding harvests and preceding flocks, and of all that has been done to maintain and increase them; so, too, if we look at the universe as a whole, the present condition of that whole is, if the scientific postulate of invariable sequence be admitted, and in as far as it is admitted, the necessary outcome of its former condition; and all the various forms of matter, whether living or inanimate, must, for the same reason and with the same limitation, be the necessary outcome of preceding forms of matter. This is the foundation of the doctrine of evolution.

Now, stated in this abstract form, this doctrine will be, and indeed if science be admitted at all must be, accepted by everybody. Even the Roman Church, which holds that God is perpetually interfering with the course of nature, either in the interests of religious truth or out of loving kindness to his creatures, yet will acknowledge that the number of such interferences almost disappears in comparison of the countless millions of instances in which there is no reason to believe in any interference at all. And, if we look at the universe as a whole, the general proposition as stated above is quite unaffected by the infinitesimal exception which is to be made by a believer in frequent miracles. But when this proposition is applied in detail it at once introduces the possibility of an entirely new history of the material universe. For this universe, as we see it, is almost entirely made up of composite and not of simple substances. We have been able to analyze all the substances that we know into a comparatively small number of simple elements—some usually solid, some liquid, some gaseous. But these simple elements are rarely found uncombined with others; most of those which we meet with in a pure state have been taken out of combination and reduced to simplicity by human agency. The various metals that we ordinarily use are mostly found in a state of ore, and we do not generally obtain them pure except

by smelting. The air we breathe, though not a compound, is a mixture. The water which is essential to our life is a compound. And, if we pass from inorganic to organic substances, all vegetables and animals are compound, sustained by various articles of food which go to make up their frames. Now, how have these compounds been formed? It is quite possible that some of them, or all of them to some extent, may have been formed from the first. If Science could go back to the beginning of all things, which it obviously can not, it might find the composition already accomplished, and be compelled to start with it as a given fact—a fact as incapable of scientific explanation as the existence of matter at all. But, on the other hand, composition and decomposition is a matter of every-day experience. Our very food could not nourish us except by passing through these processes in our bodies; and by the same processes we prepare much of our food before consuming it. May not Science go back to the time when these processes had not yet begun? May not the starting-point of the history of the universe be a condition in which the simple elements were still uncombined? If Science could go back to the beginning of all things, might we not find all the elements of material things ready indeed for the action of the inherent forces which would presently unite them in an infinite variety of combinations, but as yet still separate from each other? Scattered through enormous regions of space, but drawn together by the force of gravitation; their original heat, whatever it may have been, increased by their mutual collision; made to act chemically on one another by such increase or by subsequent decrease of temperature; perpetually approaching nearer to the forms into which, by the incessant action of the same forces, the present universe has grown—these elements, and the working of the several laws of their own proper nature, may be enough to account scientifically for all the phenomena that we observe. We do not even then get back to regularity. Why these elements, and no others; why in these precise quantities; why so distributed in space; why endowed with these properties: still are questions which Science can not answer, and there seems no reason to expect that any scientific answer will ever be possible. Nay, I know not whether it may not be asserted that the impossibility of answering one at least among these questions is capable of demonstration. For the whole system of things, as far as we know it, depends on the perpetual rotation of the heavenly bodies; and without original irregularity in the distribution of matter no motion of rotation could ever have spontaneously arisen. And, if this irregularity be thus original, Science can give no account of it. Science, therefore, will have to begin with assuming certain facts for which it can never hope to account. But it *may* begin by assuming that, speaking roughly, the universe was always very much what we see it now, and that composition and decomposition have always nearly balanced each other, and that there have been from the beginning the same sun and moon and planets and stars in the sky, the same animals on the earth and in the seas, the same vegetation, the same minerals; and that though there have been incessant changes, and possibly all these changes in one general direction, yet these changes have never amounted to what would furnish a scientific explanation of the form

which matter has assumed. Or, on the other hand, Science *may* assert the possibility of going back to a far earlier condition of our material system; may assert that all the forms of matter have grown up under the action of laws and forces still at work; may take as the initial state of our universe one or many enormous clouds of gaseous matter, and endeavor to trace with more or less exactness how these gradually formed themselves into what we see. Science has lately leaned to the latter alternative. To a believer the alternative may be stated thus: We all distinguish between the original creation of the material world and the history of it ever since. And we have, nay all men have, been accustomed to assign to the original creation a great deal that Science is now disposed to assign to the history. But the distinction between the original creation and the subsequent history would still remain, and forever remain, although the portion assigned to the one may be less, and that assigned to the other larger, than was formerly supposed. However far back Science may be able to push its beginning there still must be behind that beginning the original act of creation—creation not of matter only, but of the various kinds of matter, and of the laws governing all and each of those kinds, and of the distribution of this matter in space.

This application of the abstract doctrine of evolution gives it an enormous and startling expansion—so enormous and so startling that the doctrine itself seems absolutely new. To say that the present grows by regular law out of the past is one thing; to say that it has grown out of a distant past in which as yet the present forms of life upon the earth, the present vegetation, the seas and islands and continents, the very planet itself, the sun and moon, were not yet made—and all this also by regular law—that is quite another thing. And the bearings of this new application of science deserve study.

Now, it seems quite plain that this doctrine of evolution is in no sense whatever antagonistic to the teachings of religion, though it may be, and that we shall have to consider afterward, to the teachings of revelation. Why, then, should religious men, independently of its relation to revelation, shrink from it, as very many unquestionably do? The reason is that, while this doctrine leaves the truth of the existence and supremacy of God exactly where it was, it cuts away, or appears to cut away, some of the main arguments for that truth.

Now, in regard to the arguments whereby we have been accustomed to prove or to corroborate the existence of a Supreme Being, it is plain that, to take these arguments away, or to make it impossible to use them, is not to disprove or take away the truth itself. We find every day instances of men resting their faith in a truth on some grounds which we know to be untenable, and we see what a terrible trial it sometimes is when they find out that this is so, and know not as yet on what other ground they are to take their stand. And some men succumb in the trial, and lose their faith, together with the argument which has hitherto supported it. But the truth still stands, in spite of the failure of some

to keep their belief in it, and in spite of the impossibility of supporting it by the old arguments.

And, when men have become accustomed to rest their belief on new grounds, the loss of the old arguments is never found to be a very serious matter. Belief in revelation has been shaken again and again by this very increase of knowledge. It was unquestionably a dreadful blow to many in the days of Galileo to find that the language of the Bible in regard to the movement of the earth and sun was not scientifically correct. It was a dreadful blow to many in the days of the Reformation to find that they had been misled by what they believed to be an infallible Church.

Such shocks to faith try the mettle of men's moral and spiritual convictions, and they often refuse altogether to hold what they can no longer establish by the arguments which have hitherto been to them the decisive, perhaps the sole decisive, proofs.

And yet, in spite of these shocks, belief in revelation is strong still in men's souls, and is clearly not yet going to quit the world.

But let us go on to consider how far it is true that the arguments which have hitherto been regarded as proving the existence of a Supreme Creator are really affected very gravely by this doctrine of evolution.

The main argument, which at first appears to be thus set aside, is that which is founded on the marks of design, and which is worked out in his own way with marvelous skill by Paley in his "Natural Theology." Paley's argument rests, as is well known, on the evidence of design in created things, and these evidences he chiefly finds in the framework of organized living creatures. He traces with much most interesting detail the many marvelous contrivances by which animals of various kinds are adapted to the circumstances in which they are to live, the mechanism which enables them to obtain their food, to preserve their species, to escape their enemies, to remove discomforts. All nature, thus examined, and particularly all animated nature, seems full of means toward ends, and those ends invariably such as a beneficent Creator might well be supposed to have in view. And while there is undeniably one great objection to his whole argument, namely, that the Creator is represented as an artificer rather than a Creator, as overcoming difficulties which stood in his way rather than as an Almighty Being fashioning things according to his will, yet the argument thus drawn from evidence of design remains exceedingly powerful, and it has always been considered a strong corroboration of the voice within which bids us believe in a God. Now, it certainly seems at first as if this argument were altogether destroyed. If animals were not made as we see them, but evolved by natural law, still more if it appear that their wonderful adaptation to their surroundings is due to the influence of those surroundings, it might seem as if we could no longer speak of design as exhibited in their various organs; the organs, we might say, grow of themselves, some suitable and some unsuitable to the life of the creatures to which they belonged, and the unsuitable have perished and the suitable have survived.

But Paley has supplied the clew to the answer. In his well-known illustra-

tion of the watch picked up on the heath by the passing traveler, he points out that the evidence of design is certainly not lessened if it be found that the watch was so constructed that, in course of time, it produced another watch like itself. He was thinking not of evolution, but of the ordinary production of each generation of animals from the preceding. But his answer can be pushed a step further, and we may with equal justice remark that we should certainly not believe it a proof that the watch had come into existence without design if we found that it produced in course of time not merely another watch but a better. It would become more marvelous than ever if we found provision thus made, not merely for the continuance of the species, but for the perpetual improvement of the species. It is essential to animal life that the animal should be adapted to its circumstances; if, besides provision for such adaptation in each generation, we find provision for still better adaptation in future generations, how can it be said that the evidences of design are diminished? Or take any separate organ, such as the eye. It is impossible not to believe, until it be disproved, that the eye was intended to see with. We cannot say that light was made for the eye, because light subserves many other purposes besides that of enabling eyes to see. But that the eye was intended for light there is so strong a presumption that it cannot easily be rebutted. If, indeed, it could be shown that eyes fulfilled several other functions, or that species of animals which always lived in the dark still had fully-formed eyes, then we might say that the connection between the eye of the animal and the light of heaven was accidental. But the contrary is notoriously the case—so much the case that some philosophers have maintained that the eye was formed by the need for seeing, a statement which I need take no trouble to refute, just as those who make it take no trouble to establish, I will not say its truth, but even its possibility. But the fact, if it be a fact, that the eye was not originally as well adapted to see with as it is now, and that the power of perceiving light and of things in the light grew by degrees, does not show, nor even tend to show, that the eye was not intended for seeing with.

The fact is that the doctrine of evolution does not affect the substance of Paley's argument at all. The marks of design which he has pointed out remain marks of design still, even if we accept the doctrine of evolution to the full. What is touched by this doctrine is not the evidence of design but the mode in which the design was executed. Paley, no doubt, wrote on the supposition (and at that time it was hardly possible to admit any other supposition) that we must take animals to have come into existence very nearly such as we now know them: and his language, on the whole, was adapted to that supposition. But the language would rather need supplementing than changing to make it applicable to the supposition that animals were formed by evolution. In the one case the execution follows the design by the effect of a direct act of creation; in the other case the design is worked out by a slow process. In the one case the Creator made the animals at once such as they now are; in the other case he impressed on certain particles of matter, which, either at the beginning or at some point in the history of his creation, he endowed with life, such inher-

ent powers that in the ordinary course of time living creatures such as the present were developed. The creative power remains the same in either case; the design with which that creative power was exercised remains the same. He did not make the things, we may say; no, but he made them make themselves. And surely this rather adds than draws force from the great argument. It seems in itself something more majestic, something more befitting him to whom a thousand years are as one day and one day as a thousand years, thus to impress his will once for all on his creation, and provide for all its countless variety by this one original impress, than by special acts of creation to be perpetually modifying what he had previously made. It has often been objected to Paley's argument, as I remarked before, that it represents the Almighty rather as an artificer than a creator, a workman dealing with somewhat intractable materials and showing marvelous skill in overcoming difficulties rather than a beneficent Being making all things in accordance with the purposes of his love. But this objection disappears when we put the argument into the shape which the doctrine of evolution demands, and look on the Almighty as creating the original elements of matter, determining their number and their properties, creating the law of gravitation whereby as seems probable the worlds have been formed, creating the various laws of chemical and physical action, by which inorganic substances have been combined, creating above all the law of life, the mysterious law, which plainly contains such wonderful possibilities within itself, and thus providing for the ultimate development of all the many wonders of nature.

What conception of foresight and purpose can rise above that which imagines all history gathered as it were into one original creative act from which the infinitè variety of the universe has come and more is coming even yet?

And yet again, it is a common objection to Paley's and similar arguments that, in spite of all the tokens of intelligence and beneficence in the creation, there is so much of the contrary character. How much there is of apparently needless pain and waste! And John Stuart Mill has urged that either we must suppose the Creator wanting in omnipotence or wanting in kindness to have left his creation so imperfect. The answer usually given is that our knowledge is partial, and, could we see the whole, the objection would probably disappear. But what force and clearness are given to this answer by the doctrine of evolution, which tells us that we are looking at a work which is not yet finished, and that the imperfections are a necessary part of a large design the general outliness of which we may already trace out, the ultimate issue of which, with all its details, is still beyond our perception! The imperfections are like the imperfections of a half-completed picture not yet ready to be seen; they are like the bud which will presently be a beautiful flower, or the larva of a beautiful and gorgeous insect; they are like the imperfections in the moral character of a saint who nevertheless is changing from glory to glory.

To the many partial designs which Paley's "Natural Theology" points out, and which still remain what they were, the doctrine of evolution adds the design of a perpetual progress. Things are so arranged that animals are perpetually

better adapted to the life they have to live. The very phrase which we commonly use to sum up Darwin's teaching, the survival of the fittest, implies a perpetual diminution of pain and increase of enjoyment for all creatures that can feel. If they are fitter for their surroundings, most certainly they will find life easier to live. And, as if to mark still more plainly the beneficence of the whole work, the less developed creatures, as we have every reason to believe, are less sensible of pain and pleasure; so that enjoyment appears to grow with the capacity for enjoyment, and suffering diminishes as sensitivity to suffering increases. And there can be no doubt that this is in many ways the tendency of nature. Beasts of prey are diminishing; life is easier for man and easier for all animals that are under his care: many species of animals perish as man fills and subjugates the globe, but those that remain have far greater happiness in their lives. In fact, all the purposes which Paley traces in the formation of living creatures are not only fulfilled by what the Creator has done, but are better fulfilled from age to age. And, though the progress may be exceedingly slow, the nature of the progress cannot be mistaken.

If the "Natural Theology" were now to be written, the stress of the argument would be put on a different place. Instead of insisting wholly or mainly on the wonderful adaptation of means to ends in the structure of living animals and plants, we should look rather to the original properties impressed on matter from the beginning, and on the beneficent consequences that have flowed from those properties. We should dwell on the peculiar properties that must be inherent in the molecules of the original elements to cause such results to follow from their action and re-action on one another. We should dwell on the part played in the universe by the properties of oxygen, the great purifier, and one of the great heat-givers; of carbon, the chief light-giver and heat-giver; of water, the great solvent and the store-house of heat; of the atmosphere and the vapors in it, the protector of the earth which it surrounds. We should trace the beneficent effects of pain and pleasure in their subservience to the purification of life. The marks of a purpose impressed from the first on all creation would be even more visible than ever before.

And we could not overlook the beauty of nature and of all created things as part of that purpose, coming in many cases out of that very survival of the fittest of which Darwin has spoken, and yet a distinct object in itself. For this beauty there is no need in the economy of Nature whatever. The beauty of the starry heavens, which so impressed the mind of Kant that he put it by the side of the moral law as proving the existence of a Creator, is not wanted either for the evolution of the world or for the preservation of living creatures. Our enjoyment of it is a super-added gift certainly not necessary for the existence or the continuance of our species. The beauty of flowers, according to the teaching of the doctrine of evolution, has generally grown out of the need which makes it good for plants to attract insects. The insects carry the pollen from flower to to flower, and thus, as it were mix the breed; and this produces the stronger plants which outlive the competition of the rest. The plants, therefore, which are most

conspicuous gain an advantage by attracting insects most. That successive generations of flowers should thus show brighter and brighter colors is intelligible. But the beauty of flowers is far more than mere conspicuousness of colors, even though that be the main ingredient. Why should the wonderful grace, and delicacy, and harmony of tint be added? Is all this mere chance? Is all this superfluity pervading the whole world and perpetually supplying to the highest of living creatures, and that, too, in a real proportion to his superiority, the most refined and elevating of pleasures, an accident without any purpose at all? If evolution has produced the world such as we see and all its endless beauty, it has bestowed on our own dwelling-place in lavish abundance and in marvelous perfection that on which men spend their substance without stint, that which they value above all but downright necessities, that which they admire beyond all except the law of duty itself. We cannot think that this is not designed, nor that the Artist who produced it was blind to what was coming out of his work.

Once more, the doctrine of evolution restores to the science of nature the unity which we should expect in the creation of God. Paley's argument proved design, but included the possibility of many designers. Not one design, but many separate designs, all no doubt of the same character, but all worked out independently of one another, is the picture that he puts before us. But the doctrine of evolution binds all existing things on earth into one. Every mineral, every plant, every animal has such properties that it benefits other things besides itself, and derives benefit in turn. The insect develops the plant, and the plant the insect; the brute aids in the evolution of the man, and the man in that of the brute. All things are embraced in one great design, beginning with the very creation. He who uses the doctrine of evolution to prove that no intelligence planned the world, is undertaking the self-contradictory task of showing that a great machine has no purpose by tracing in detail the marvelous complexity of its parts, and the still more marvelous precision with which all work together to produce a common result.

To conclude, the doctrine of evolution leaves the argument for an intelligent Creator and Governor of the world stronger than it was before. There is still as much as ever the proof of an intelligent purpose pervading all creation. The difference is, that the execution of that purpose belongs more to the original act of creation, less to acts of government since. There is more divine foresight, there is less divine interposition; and whatever has been taken from the latter has been added to the former.

Some scientific students of nature may fancy they can deduce in the working out of the theory results inconsistent with religious belief; and in a future lecture these will have to be examined; and it is possible that the theory may be so presented as to be inconsistent with the teaching of revelation. But, whatever may be the relation of the doctrine of evolution to revelation, it cannot be said that this doctrine is antagonistic to religion in its essence. The progress of science in this direction will assuredly end in helping men to believe with more assurance than ever that the Lord by wisdom hath founded the earth, by understanding hath he established the heavens.—*Popular Science Monthly.*

ON RAPID CHANGES IN THE HISTORY OF SPECIES.

Mr. Thomas Meehan exhibited flowers of the remarkable *Halesia* noted at page 32, and remarked on the wide divergence reached without any intervening modifications from the original, and observed that it was another illustration of what he thought must now be generally accepted, that the maxim of Ray "*Natura non facit saltum*" itself needed modification. He had called attention to this particular departure, among others, in a paper before the *American Association for the Advancement of Science*, in 1874;[1] what he desired to do now was to emphasize a few of the points brought out prominently in that paper, that "Variations in species as in morphological changes in individuals, are by no means by gradual modifications; that suddenly formed and marked variations perpetuate themselves from seeds, and behave in all respects as acknowledged species; and that variations of similar characters would appear at times in widely separated localities."

In addition to the illustrations given in that paper, a remarkable one was afforded by the *Richardia æthiopica*, the common "calla" of gardens, the present season. Some four inches below the perfect flower a mere spathe was developed, partially green, but mostly white, as usual, but in this case we do not call it a spathe, but a huge bract. In other words, the usually naked flower-scape of the *Richardia* had borne a bract. Flowers with a pair of more or less imperfect spathes were not uncommon in some seasons; the peculiarity of the present season was the interval of several inches on the stem, which justified the term of bract to the lower spathe. From the vicinity of Philadelphia numbers had been brought to him, and others had been sent from Ohio, Indiana and Illinois—some hundreds of miles apart. What was the peculiarity in this season over others which induced the production of this bract, was one question. Whatever it may have been, it operated in bringing about a change of character, without the intervention of seed, directly on the plant, and in many widely separated places at the same time. What is to prevent a law which operates exceptionally in one season, operating again and in a regular and continuous way? So far as we can understand there can be no reason; and, if it should, we have a new species, not springing from a seed, or one individual plant—constituting one geographical centre of creation from which all subsequent descendants emigrated and spread themselves—but a whole brood of new individuals already widely distributed over the earth's surface, and entirely freed from the "struggle for existence" which the developement of a species from a solitary individual pre-supposes.

Aside from the great value of this illustration of how the whole character of a species might be modified simultaneously over a wide extent of country, it afforded a lesson in environment. External circumstances may influence modification, but only in a line already prepared for modification. This must necessarily be so, or change would be but blind accident, whereas palæontology teaches

1 See Proc. Amer. Assoc. Ad. Science, volume xxiii, p. B. 9.

us that change has always been in regular lines, and in co-ordinate directions which no accident has been able to permanently turn aside. Just as in the birth of animals, we find, that however powerful may be some external law of nutrition, which, acting on the primary cell of the individual decides the sex, yet we see that no accident has been able to disturb the proportion of the sexes born, which has always been, so far as we know, nearly equal. So in the birth of species, making all allowances for the operation of environment, the primary plan has been in no serious way disturbed; we have to grant something to environment in the production of new forms, but only as it may aid in innate power of change, ready to expend itself on action as soon as the circumstances favor such development—circumstances which after all have very little ability to determine what direction such change shall take.

We know that distinct forms do spring through single individuals from seed, and that after battling successfully with all the vicissitudes of its surroundings, a new form may succeed in spreading, through the lapse of years or ages, over a considerable district of country. But the idea that always and in all cases species have originated in this manner, presents, occasionally, difficulties which seem insurmountable. In the case of the similarity between the flora of Japan and that of the eastern portion of the United States, we have to assume the existence of a much closer connection between the land over what is now the Pacific Ocean, in comparatively modern times, in order to get a satisfactory idea of the departure of the species from one central spot; and to demand a great number of years for some plants to travel from one central birthplace before the land subsided, carrying back species in geological time further, perhaps, than mere geological facts would be willing to allow. But if we can see our way to a belief that plants may change in a wide district of country simultaneously in one direction, and that these changes once introduced, be able to perpetuate themselves till a new birth-time should arrive, we have great advancement towards simplifying things.—*Proceedings of Philadelphia Academy of Science.*

ASTRONOMY.

SUN AND PLANETS FOR JANUARY, 1885.

W. DAWSON, SPICELAND, IND.

About an hour before New Year's the Sun is in Perigee, its nearest point to the Earth, when its R. A. is 18h. 48m.; and declination 22° 00′ S. Thus it has started northward and the days are growing longer. Spots on the Sun have broken out considerably since their disappearance November 8th. On the 14th of November there were five groups and fifty spots. December 2d four

groups and sixty-six spots. On the the 8th I counted only fourteen spots. The weather has been unfavorable since then—now the 18th.

New Moon occurs January 16th, about 3:00 A. M., and Full Moon on the 30th at 11:00 A. M. The Moon passes over and hides for nearly an hour, the star Theta Libræ, in the morning of January 10th, about 3:00 to 4:00 o'clock. Another phenomenon of considerable interest will occur near 7:00 P. M., January 28th, viz.: the passage of the Moon very near a star (Lambda in Gemini) so that the star will appear to pass very near the south edge of the Moon, and may be actually hid for a few moments. In such a case it may be possible, with a good telescope, to see the star disappear and re-appear alternately among the high mountains on that part of the Moon. Such an observation would, at least, be quite interesting.

Mercury comes to inferior conjunction with the Sun January 3d; and greatest elongation on the 26th, when it will be nearly 25° W. of the Sun, and may be observed as a moving star. Venus is still a Morning Star in the southeast. Mercury will be 1° north of it in the morning of the 24th. Mars is too near the Sun to be visible. Jupiter rises some north of east about 9:00 o'clock January 1st; and at 7:00 o'clock on the 31st. So it will be in good position for observation toward the last of the month. Its four moons may be seen with a spy-glass. Saturn is as well situated for evening observation as it can be. It is considerably below and north of Pleiades, forming a triangle with them and Capella. It is three hours high at 6:00 o'clock January 1st. Its ring and one moon (Titan) can be seen with a good-sized spy-glass. Uranus is nearly between the stars Eta and Gamma of Virgo, just visible to the naked eye when the sky is clear and Moon absent. Neptune is in a starless region of Taurus, about 8° southwest of Pleiades. It is quite invisible to the naked eye, and can only be found by the aid of an equatorial telescope.

NATURAL HISTORY.

ODDITIES OF ANIMAL CHARACTER.

Mr. J. S. Mill, in his essay on "Liberty," long ago warned us against the stupefying influence of custom upon human beings, and held that we ought to encourage eccentricities in each other, and to guard jealously the right to be eccentric, instead of insisting on reducing every one by the hard-and-fast Procrustean standard to a single dead level of mediocrity. But, whatever our sins may be in this respect toward human beings, surely they are greater still toward the domestic animals. We reduce our horses, so far as possible, to the mechanical condition of locomotive engines—indeed, eccentric horses might involve very serious dangers to life and limb—our dogs to sentinels, which we drill to a social

decorum as rigid as our own; while we regard the eccentricities of a cat with undisguised horror, as the mere prelude to dangerous insanity. No one who watches can fail to see how bigoted we are against anything like a "new departure" among our poor relations. If a man begins to save up against his old age, we call it thrift, and praise him as a small capitalist who is giving hostages to fortune; but if a dog accumulates a store of bones or food, we look upon him as indulging in dangerous caprices, which may end in the necessity of putting a bullet through his head. There may be exceptions here and there. Sometimes you will find an old lady who will protect eccentricity in a parrot, a magpie, or a jackdaw, as a bird that has a right to a certain freedom of movements in return for its entertaining attempts at conversation.

But, on the whole, there is no sterner standard of conventionality than that which we enforce on our domestic animals. Pet dogs become perfect bigots in favor of the usual, and persecute any attempt to deviate from it on the part even of a more powerful and less favored colleague, as the Inquisition persecuted heresy, or as the court of Russia persecutes Nihilism. There is nothing equal to the indignation of an in-doors dog at any invasion of the privacy of the drawing-room by an out doors dog, and nothing more melancholy than the servile apologies which the big dog will make to the little one, for even proposing to break through the animal etiquette of the house. The horror of the queen's chamberlain, when once an officer presented himself at the *levee* in the proper court suit diversified by slippers, which he had forgotten to exchange for the regulation boots, was not so great as the horror of the terrier and the Pomeranian when a collie or a setter presents himself on the threshhold of their mistress' sitting-room. We smother the genius of our dogs with our conventionalisms, and stifle the originality of our cats with luxurious bribes. We did, indeed, meet the other day, within the precincts of a great cathedral, with a young cat who was spoken of as "epoch-making"—as likely even to originate a new hegira by the fervor of his genius. But even of his great promise we could gather no articulate account. He was still in the period of early youth, and perhaps was brooding over the designs by which he hoped to transform, in some future day, the world of the cathedral close. But, as a rule, it is certain that we teach our domestic animals as the Cingalese teach their tame elephants, to discourage steadily and effectually everything like eccentricities, whether deliberate or capricious, or assertions of liberty, on the part of their wilder colleagues, and so drill them into our dead level of habit.

What important variations of character, however, might we not promote if we took more pains to foster what a writer of thirty years used to call "the individuality of the individual" among our friends of the lower races! Sir John Lubbock thinks that he has partially taught a poodle to read, but, as a correspondent of ours once suggested, that may be a step in the wrong direction—not a development of the true genius of the dog, but an attempt to merge the genius of the dog in the habits peculiar to man, and likely rather to result in ingrafting an imitative humanity on a totally different kind of capacity. On the other hand,

in his experiments on ants, Sir John Lubbock has gone on the sounder principle of setting the ants problems to solve for themselves—a principle which has resulted in showing that different races of ants have very different resources and that different individuals, even in the same race, show a very different amount of resource in dealing with the same difficulty. This is confirmed by what we know of our more intimate friends among the domestic animals; and surely we should do more to develop their capacity by stimulating them to meet difficulties by their own resources than we can effect by taking their training so completely under our own care. Is it not possible that, as things go, the companionship of man is rather an incubus on the natural genius of the inferior animals than a a help to its development? It is clear that the ants, at least, are more sagacious in proportion as they live more apart from man, and are thrown upon their own resources. The harvesting-ants of Texas and the leaf-cutting and military ants of Nicaragua are far higher in civilization than the ants of the more densely peopled countries of Europe. In proportion as they have a freer scope for their efforts, their social communities appear to be founded on a more advanced intelligence and organization. Is it not possible that we stunt the intelligence of our humbler fellow-creatures by doing so much for them, and permitting them to do so little for themselves?

Certainly there is far too little disposition to allow of eccentricity in the lower animals and for what comes of eccentricity. Half-domesticated birds, however, will occasionally show very remarkable eccentricities, and even appear to be making experiments—though experiments which we should, of course, regard as of a very unscientific kind—in the modification of their own instincts. The present writer knows a pigeon of exceedingly eccentric disposition, not unlike "the single gentleman" in Dickens' "Curiosity Shop" in his habits. He keeps seven pigeon boxes all to himself, and persecutes relentlessly any pigeons which propose to share their dwellings with him. He is as averse to the society even of the gentler sex as was St. Anthony himself in Egyptian deserts. Not a pigeon will he admit within the circle of his sway. And yet, in spite of this resolute and inveterate bachelorhood, this eccentric pigeon is always endeavoring to build nests, and looking out for objects of an egg-like form, which he thinks it possible to hatch. He will accumulate twigs and straws now here, now there, at very great pains and labor. He will coo sometimes to inanimate objects, sometimes to captive birds of another breed, sometimes to a kitten or a dog, or even a flower-pot, with the quaintest and politest antics. He will sit patiently on China-saucers on the mantel-piece of one room, while he accumulates the materials for a nest on the top of a closet in another room. He does not even drive away the possible mother of a family with more zeal than he shows in seeking to be a good father to some imaginary chick which he seems to expect to elicit from a ring-stand or a letter-weight. So for as the writer can judge, he is a pigeon of strong Malthusian views, who hopes to inaugurate a new *regime* which may have the same relation to the ordinary habits of pigeons which the Positivist worship bears to

the other religions of the world. He hopes to foster and cultivate the family and parental idea without any corresponding reality, without any aid from outside, indeed, except an apparatus of external ceremony, which feigns the existence of a purely ideal mate, and affects to indulge in the expectation of impossible offspring. Doubtless he thinks that there is nothing so good as the courtly attitude of a pigeon toward his mate, especially if there be no mate to justify it; nothing more touching than the patient preparation for offspring and the education of the young, especially if there be no young to complicate the problem of tenderness and foresight, by requiring a real supply of food and attention.

This eccentric pigeon seems to be a solitary thinker of the Comtist kind, who hopes to solve the problem of preserving to the full all the higher instincts of bird-life, without the difficulties involved in supplying those instinct with real objects. If a human thinker can empty religion of its meaning, and yet justify all its forms and sentiments and external rites, and if he is to receive nothing but praise for his achievement, why may we not regard with interest and admiration the effort of an eccentric bird to retain all the ceremonial forms of chivalrous observance and elaborate parental care and patience, without, in fact, complicating the situation by admitting the neighborhood of either wife or child? To our mind, the idiosyncrasies of such a creature as this deserve the most attentive study. Who knows whether we might not find in the world of eccentric instinct all sorts of anticipations of eccentric intellect? Who knows whether we might not find genius and originality in other races of animals which would throw as much light upon the genius and originality of man as the eccentricities of this pigeon seem to throw on the eccentricities of a most active and confident school of modern thought? If John Stuart Mill were right in thinking it a sacred duty not to discourage the milder lunacies of human beings, might we not with equal advantage extend his exhortation, and make it include the duty of protecting the independent development of the idiosyncrasies of bird and beast, in the hope of finding in them some clew to the various oddities and harmless insanities of human thought and action?—*American Field.*

BOOK NOTICES.

SECOND ANNUAL REPORT OF THE BUREAU OF ETHNOLOGY, 1880–81: By J. W. Powell, Director. 8vo., pp. 477. Illustrated. Government Printing Office, 1883.

The first part of this handsome volume consists of an account of the operations of the Bureau for the fiscal year by Major Powell himself, the remainder is devoted to special papers by his assistants, illustrating the methods and researches prosecuted under the direction of the Bureau.

Among these papers are an account by Frank H. Cushing, of the Smithson-

ian Institution, of some peculiar rites studied by him while living with the Zuni Indians of New Mexico, entitled "Zuni Fetiches;" one by Mrs. Erminnie A. Smith, entitled "Myths of the Iroquois;" a third by H. W. Henshaw upon "Animal Carvings from Mounds of the Mississippi River;" "Navajo Silversmiths," by Washington Matthews; "Art in Shell of the Ancient Americans," by Wm. H. Holmes; "Illustrated Catalogue of the Collections obtained from the Indians of New Mexico and Arizona in 1879 and 1880," by James Stevenson.

All of these articles are written by persons who have given careful and critical study to their respective subjects and most of them are very copiously illustrated in the handsomest manner.

The investigations of the Bureau have been conducted systematically and the object has been the definite and logical study of arts, institutions, languages, and opinions, each depending upon, and to some extent inseparable from, the other. As Major Powell well puts it, "The study of the arts is but the collection of curiosities unless the relations between arts, institutions, language and opinions are discovered. The study of institutions leads but to the discovery of curious habits and customs unless the deeper meaning thereof is discovered from arts, languages and opinions. In like manner the study of words unless philologic research is based upon a knowledge of arts, institutions and opinions. So also the study of opinions is but the collection of mythic stories if their true meaning is not ascertained in the history of arts, institutions and languages."

With this view of the subject properly understood, the student of ethnology will not long be regarded by the average person as a mere collector of old pottery, arrow-heads and musty bones, but will soon come to occupy his proper place among scientists.

TRAVELS ON FAITH FROM TRADITION TO REASON: By Robt. C. Adams. 12mo., pp. 238. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson.

This handsomely printed volume is devoted to an account of the writer's experiences in passing from a supposed religious state, through all the phases of doubt and unsettlement, to that of rank infidelity. He is the son of a Presbyterian minister and was brought up by a Christian mother, being taught, as all New England children were in those days, the stern theology of the "shorter catechism" and other Calvinistic doctrines. With such a foundation it is surprising how soon he began to doubt, and more surpsising upon what meagre quibbles his doubts depended. He became a sea captain and having much leisure time on his hands, devoted it to studying the Bible and theological books. He attended church when on land, and apparently earnestly sought to be a Christian and lead a Christian life. Nevertheless his hold upon religion was too slight to bind him and he drifted farther and farther from the teachings of his youth until he actually became a "pagan" of the Bob Ingersoll type, satisfied with being

[illegible] passages [illegible] in a [illegible] of [illegible]'s purposes and [illegible]

[illegible] readings and studies is [illegible] necessary [illegible] principles and [illegible] a full grasp of [illegible] in his understanding of [illegible] a reasonable conception of [illegible] The whole work [illegible] misdirected energy, together with [illegible] will [illegible] in any branch of [illegible]

[illegible] library [illegible] read by the [illegible] mature person of well [illegible]

[illegible] History of the United States. By Edward S. Ellis. 12mo., pp. [illegible] Van Antwerp, Bragg & Co., Cincinnati, 1884. For sale by M. H. [illegible]

[illegible] series published by the [illegible] paper, printing and illus[illegible] middle-aged persons than the great [illegible] books, both in matter and [illegible]

[illegible] than to chronicle in simple [illegible] events, explain the causes of national movements, [illegible] progress of the United States in everything [illegible] The review questions appended to each chapter are [illegible] in indicating memorable points and fixing them in his mind. [illegible] books deserve a place in all good schools.

Report of an Archæological Tour in Mexico in 1881: By A. F. Bandelier. 8vo., pp. 326. Illustrated. Cupples, Upham & Co., Boston, 1884.

This is the second volume of archæological papers published by the Archæological Institute of America, whose president is Charles Eliot Norton and whose secretary is E. H. Greenleaf. The author calls his work an archæological reconnoisance into Mexico, and divides it into four chapters, viz: From Tampico to the City of Mexico; Notes about the City of Mexico; Studies about Cholula and its vicinity; An Excursion to Mitla.

There are twenty-six plates, most of them heliotypes, with hundreds of figures

and illustrations in the text. Many of these are from drawings by the author and the remainder from photographs.

Mr. Bandelier has been employed for several years past by the Institute, first in New Mexico where he studied the Pueblos, and afterwards in Old Mexico where he has devoted himself to the interesting ruins of that country. He is a graceful and interesting writer and an explorer who knows what to look for and how to investigate it, which is more than can be said of all explorers. The subject, though old, is ever attractive, and though Humboldt and LePlongeon, Bancroft and Charnay, besides numerous Spanish, French and Italian explorers, have described these wonderful ruins over and over for several centuries past, this new story of their mystery and grandeur will be read with renewed and undiminished interest.

The Institute has put it forth in handsome style, through its publishers, and can supply any demand upon application to Mr. Greenleaf.

Proceedings of the Academy of Natural Sciences of Philadelphia, May to October, 1884. Edited by Edward J. Nolan, M. D. 8vo., pp. 144. 1884.

The promptness with which this volume has been produced, so unusual with scientific bureaus and societies, is worthy of all commendation. Its contents are, as heretofore, highly attractive from their originality and the nature of most of the subjects discussed. We find among the contributors the names of Professors Leidy, Meehan, Gill, Lewis, Doctors Foote and Brinton, Rev. H. C. McCook and several others less well known in the West. Among the, to us, more interesting papers we note that upon Rapid Changes in the History of Species, by Prof. Thomas Meehan; Rev. Mr. McCook's articles upon the Habits of Spiders, and that of Dr. D. G. Brinton upon "The so-called Bird-Track Rock Sculptures of Ohio." Other papers will commend themselves to other readers who are interested in biology, botany, geology, physiology, etc.

No society of the kind in this country does more original or better work than this.

OTHER PUBLICATIONS RECEIVED.

Signal Service Notes, No. XVI: The Effect of Wind Currents on Rainfall, by G. E. Curtis, U. S. Government Printing Office. Humboldt Library, Double Number, 30cts., No. 62—The Religions of the Ancient World, including Egypt, Assyria, Babylonia, etc., by Rawlinson, M. A., published by J. Fitzgerald, N. Y. A Manual of Geology, with classification tables, by Prof. S. H. Trowbridge; published by National School Furnishing Co., Chicago Ill. Oxygen and Ozone: Their Applications, by Prof. Anton Stamm; published at Leadville, Colo. A Spectro-Photometric Study of Pigments, by Edward L. Nichols, Ph. D. Bul-

letin of U. S. Geological Survey No. 9, Government Printing office. Economic Tracts No. 14: The Competitive Test, by Edward Shepherd; published by Society for Political Education, New York. Humboldt Library No. 60—The Childhood of the World: An Account of Man in Early Times, by Edward Clodd, F. R. A. S., price 15cts; Fitzgerald, publisher, New York. Questions of the Day, No. 13: Public Relief and Private Charity, by Josephine Shaw Lowell, price 40cts; G. P. Putman's Sons, New York. Humboldt Library, No. 61, price 15cts: Miscellaneous Essays, by Richard A. Proctor; Fitzgerald, publisher, New York. Annals of Mathematics, by Ulmund Stone and M. Thornton, Vol. 1, No. 3, Charlottesville, Va. The Song Friend, Vol. 5, No. 12; published by W. S. Staub, Chicago, $1.00 a year. Professional Papers of Signal Service, No. 14: Charts of Relative Storm Frequency for a portion of the Northern Hemisphere, by John P. Finley, Government Printing Office. Economic Tracts, No. 15, The Standard Dollar, by H. W. Richardson, N. Y. U. S. Consular Reports: Reports of Consuls of U. S. on Commerce, Manufacture, etc., of their Consular Districts, No. 45, Government Printing Office.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

Combined Cuff-Holder and Sleeve-Support.—This invention relates to that class of devices in which the cuff is supported by spring clamping-jaws, and it consists of an S-shaped strip of metal that is so combined with a suitable pin as to be adapted for fixture within a coat-sleeve, where, by reason of its spring-jaws it will hold the cuff securely in place.

By dispensing with the pin, however, the strip of metal becomes simply a support for the wristlet of the sleeve, and it is applied by placing it upon the edge of the cuff, in which position it is held by reason of its inherent spring power. Now upon the entrance of the descending wristlet within the cuff, it comes in contact with the inwardly-projecting arm of the instrument and is thereby prevented from falling so low as to be exhibited upon the wrist.

In construction, a suitable piece of metal being provided, it is bent at one-third its length or doubled toward its main position to form the two clamping-arms and in an opposite direction to form the supporting-arm. The pin may then be, or may not be, attached as desired.

Electrical Game-Indicator for Pool Tables.—This improvement provides an efficient indicator whereby the person in charge of a number of tables is

instantly made aware of the beginning of a game and of the particular table upon which it is in progress.

The apparatus consists mainly in constructing both the spot and the triangle of metal, and of placing them in electrical communication with a suitable indicating dial.

The improved metal spot is preferably constructed with a shoulder near its upper end for forming a bearing when it is let down level with the upper surface of the table. A pin or dowel is provided upon its lower extremity in the form of a binding screw to which the circuit-wire is attached. The spot is perfectly insulated in its position upon the table.

In operation, a battery and an indicating dial are located at such a point in the room as will be convenient for inspection, the spot and the tri-angle are connected by suitable wires to the battery and to the dial. Whenever the table is idle the tri-angle is of course removed from the spot, but, when a game is commenced, the tri-angle is placed in position upon the table in contact with the metal spot, the circuit is thus closed and the fact is indicated by the dial.

THOUGHTS ON SCIENCE TEACHING.

ALEXANDER WINCHELL.

The so-called "inductive sciences" are by no means exclusively inductive. Nor can all science-teaching be conducted exclusively by observational methods. On these two points much erroneous doctrine has been inculcated. Aside from certain rational principles which regulate all intellectual processes, it may be said that the so-called inductive sciences begin by induction, and are founded on facts of observation. The knowledge of the facts is the condition of the existence of the science. The facts, while not constitutive of science, are the data of science; and in a process of education they must be acquired. A real portion of the science consists of the body of generalizations based on the facts. Any real knowledge of the science must grasp these principles. But the body of propositions generalized from the data of science may next be employed as grounds of deductive inference. Only thus does science attain to a knowledge of facts inaccessible to observation. Thus science becomes a seer, and her vision penetrates beyond the limited range which bounds the ken of the human race. It is only by deduction from generalized principles that geology, for instance, can venture any affirmation concerning the history of the world in the ages before human observation, or can predict vicissitudes impending in the remote future. Those portions of a science reasoned out from general principles often constitute its most important domain. They generally afford the most entertaining and inspiring themes for contemplation, and this is evidently because the method carries us through time and space and causation to distances most remote from the little circle which limits the sphere of facts merely observed.

We are thus reminded that the subject matter of science, aside from the transcendental concepts and cognitions which are always implied, consists of: 1. Facts of observation. 2. Principles generalized from the facts. 3. Other facts deduced from those principles.

Here are three different kinds of knowable materials to be dealt with by the teacher of science. As to the facts, it scarcely needs to be said that the most effective method of imparting a knowledge of them to others is the *observational*. If the facts of science are to be learned, the best way is to bring the facts and the learner together. The method of the Kindergarten, the laboratory and the field is truly the most efficient and the most agreeable. Too much can not be said of the importance of giving full exercise to the percipient faculties, within all the range where their activity is possible. But next, if direct observation is impossible, the *pictorial* method is the best substitute, provided the pictures are intelligible and correct. Poor pictures are misleading and a weariness. But if these are not available in imparting a cognition of the facts, we must employ the *descriptive* method. Here everything depends on the clearness of the describer's conception of the thing, and the power of the learner to picture mentally the thing described. These are powers of the imagination. Their exercise by the teacher gives vividness, reality and clearness to the fact set forth. Their exercise by the learner gives vividness of conception which is the next thing to visual perception. In the description of objects of natural history, some describers, with the object before them, can not phrase a description out of which a picture could be formed. Some who read the most accurate and vivid descriptions have no power to render them in a clear mental picture. Hence the descriptive method as a dernier resort, is neither to be employed undiscriminatingly, nor condemned unconditionally.

Next, as to the generalizations, the *ratiocinative* process of acquisition should be promoted in all cases; but where the powers of the learner are incapable of seizing the generalization, it must be enunciated *dogmatically*. The generalization is the first attainable constituent of the science. It is of pre-eminent importance, and is imagined by some to be the only genuine scientific material. It is well if the pupil can view the facts under such a presentation as to draw the inference for himself. But the inference must come into his possession, if only received on the authority of the teacher.

As to the deductive materials of science, they presume the existence of generalized principles, and their acquisition by one of the two methods just indicated. The deductive inferences from them should be drawn by the unaided action of the learner's intelligence, where the process is not too recondite. More frepuently, however, the learner can do no better than to listen to the detail of inferences drawn by a teacher of adequate knowledge, reflection, and power of statement. The teaching is either *ratiocinative* or *dogmatic*.

The data and principles of science and of teaching, thus recalled to mind, reveal, manifestly, a certain range of scientific knowledge which may be approached by the observational method, and should be so approached. The acquisition of all which remains must be left to the action of the learner's ratiocin-

ative powers, or, more frequently, to the dogmatic enunciations of the teacher. This discrimination cannot possibly be ignored. To insist that all scientific acquisition shall be by the observational method, is to betray ignorance of the material of science. The most important, the most real and the only fundamental part of science is accessible only to rational perception, not to sensible perception. To denounce the didactic or descriptive presentation of facts is to assume that all facts can be brought before the sense of the learner, and this is a baseless assumption. To denounce all dogmatic statement of general principles, is to assume that the tottering intellect of the young learner is capable of drawing the same generalizations as have been framed by the sturdiest efforts of experts, and this is a baseless assumption. To denounce all dogmatic statement of deductive inferences is to confess inability to perceive the cogency of *a priori* evidence, and thus abdicate the privilege of passing judgment on it; or, if the validity of deductive science is admitted, it is to assume that the learner is already capable of taking, unsupported, the loftiest flights of scientific speculation—a consequence, the very mention of which annihilates the assumption. There must be sometimes a descriptive statement of facts. There must be a dogmatic delivery of inductive doctrines. There must be, unless we would have our teaching grossly defective, a frequent dogmatic exposition of the necessary consequences of established principles.

Finally, as to the times and circumstances under which these various methods of teaching may be employed, we have a few words to offer. Let us first consider the learner of tender years. It requires no argument to make it appear that the generalized and deductive principles of science are not appropriate, or, in any event, are less appropriate, than the facts, to the active percipient powers and the late awakened reflective powers of the young. It seems, however, to require argument to establish the belief in the minds of educators, that the learning of the facts of science is positively suitable to the faculties and aptitudes of the young. If the proposition were accepted, we should not see children and youths shut up for years to the abstractions of arithmetic and grammar, the sporofic and comparatively unproductive details of historical names and dates, or the meaningless and profitless lists of capes and headlands along some remote barbaric shore. We are not denying the usefulness of these things, nor even their comparative usefulness. We strongly feel, however, that during the stage of childish perceptivity, there is greater appropriateness and productiveness in the exercise of the faculties upon facts of present interest, and which actually enter into the organization of sciences of transcendent influence and importance. But, whatever finally may be agreed as to the propriety of introducing the natural sciences to the attention of the child, it can hardly be denied that the most rational method of doing this is to bring the child into contact with the facts, and leave his own mind, as far as it is able, to draw the general inferences to which the facts point. It follows that books and teachers which aim at a systematic, synthetic presentation of one of the natural sciences, forget the order of development of mental faculties, and prepare to leave a sense of weariness and disgust where there

might be a feeling of interest and delight. The only rational procedure with the child, in the study of rudimentary geology, for instance, is, therefore, to take him into the field and permit his faculties of observation and thought to lead him, by the natural processes of investigation and discovery, to the apprehension of those principles which constitute the inductive department of the science. His own faculties then are active, and to some extent, in all cases, the principles reached are principles discovered; the child feels a consciousness of success—a pride in it, an exhilaration over it, and the whole exercise is a delight.

If the case be that of a person entering on a thorough course of scientific study, then equally, an examination of the facts which constitute the data of the science is the first thing in natural order. This is the nature of the study in an elementary course, whether the pupil be a child in the grammar school or a senior in college. But the style of the presentation will vary with the maturity of the learner, and so will the prompting needed in drawing the appropriate lessons from the facts. It is a needlessly prosaic, heavy and deadening process to start a course in science with the conning and memorizing of abstract general statements which rest on no evidence visible to the learner, and sustain no recognized relation to any body of knowledge which interests and inspires, and lifts up the mind. With all the inspiration which belongs to science, it is easy to give it a cold and soporific presentation to the beginner. The order of ideas in the historic development of a science is nature's order in the development of the same ideas in the individual mind. What is most natural is most pleasant and most profitable.

As the study of the science proceeds, the student's mind is prepared for the reception of the higher generalizations, and the far-reaching results of deductive reasoning. The skillful teacher will cause the data to pass before the learner's mind in such order as to prompt the mind, through its own energy, to reach these inferences as original discoveries. That is the best teaching, and those are the best text books, which secure the most of this productive spontaneity. But, as before stated, much must always be enunciated by authority. Especially, while the person continues in the relation of pupil rather than independent investigator, will it remain appropriate and best for the teacher in his own language and way, to enlarge upon the far-reaching consequences of those modes of being and action which are expressed in the higher generalizations of science. To trace those consequences leads the learner's thoughts and imagination into realms so remote from present experience that novelty and wonder lend new incentives to attention and add exalted interest to the conceptions of the science. These higher generalizations and loftier deductions are a grand sequel to the earlier details of facts and the later formulation of doctrines, and they may advantageously be reserved for formal lecture presentation.

There are still other circumstances in which every teacher of science is liable to find himself sometimes placed. Multitudes of persons who cannot or will not pursue any thorough course of scientific study, still desire a knowledge of the grand results of science. This, indeed, is all which the world at large cares for.

It is in truth all which enters into the cultural influence which science exerts upon the intelligence of the masses. Now, as has been shown, this class of scientific knowledge, to those who have not reasoned up to it from the facts, must necessarily be imparted by means of dogmatic statements, and the learner must rest content with the results, ignorant, largely, of the data from which they have been reached. This may be half-knowledge, but beyond question, it may be very interesting and very valuable knowledge. This is the department of scientific knowledge best suited for impartation through popular lectures. It is the aspect of science to which the popular intelligence always turns with eagerness. Still, it is not to be supposed that the highest appreciation requires the exclusion of all statements of fact. The mind—even the popular mind—takes delight in its own activity. It likes to trace the relations of causality by means inductive and deductive. The lecturer, for instance, may direct the attention of his hearers to the familiar phenomena of erosion, occurring within the narrow sphere of his own observation. The hearer will easily follow the generalization of this action into a universal phenomenon; and then, by a mental process equally agreeable, he will accompany the lecturer in a delineation of the ulterior consequences of such geological action. The experimental sciences afford superior opportunities for conducting the hearer over the steps of fact, generalization and deduction. But to assume that no popular instruction in science is legitimate which does not accompany every conclusion by its appropriate proof, is the affectation of a mind which has been running in a rut. To summarize results, we may say that instruction in natural science intended for youthful learners, should deal chiefly with the concrete data, giving occasional glimpses of the ratiocinative procedures to be based on them. Definitions and general enunciations should come at the end instead of the beginning. This work compasses the rudiments of the science. For all persons entering on a thorough course, a similar method should be pursued, extending the range of logical inferences as knowledge accumulates, or the maturity of the learner is more advanced. The inductive method may well be supplemented by formal, descriptive, didactic and dogmatic presentations.

This instruction may cover the fundamental facts and doctrines, and the prominent theories in the science. It embraces the elements of the subject, and ought always to be acquired during the preparation for college. The third phase of scientific teaching, which may be noted as collegiate, should combine the same method with a larger supplement of lectures designed to gather into a unity, with a clearer co-ordination of parts, the somewhat disjointed results of observational and inductive study, and to lead the learners mind over the lofty ranges of remoter generalization, and ulterior results of the causes in action. A fourth form of presentation is the popular, in which the interest and profit of the learner require a minimum of facts and a maximum of general conceptions. Thus the method of instruction in natural science is not one and uniform. It must vary with the subject matter and with the age and aims of the learner. It may be rudimentary, preparatory, collegiate or popular, and in each case a different pro-

portion of the concrete and reflective constituents of science must be presented to the mind.—*Fortnightly Index.*

THE NATIONAL EXHIBIT AT THE NEW ORLEANS EXPOSITION.

In addition to the grant of $1,000,000 made by Congress as a loan to further the project of a World's Fair, and Cotton Centennial in New Orleans, an appropriation of $300,000 was made to enable the various departments of the national Government that are depositories of the nation's historic and industrial annals to make a fitting display. The most imposing and valuable exhibits will be made by the various bureaus comprised in the interior department, represented by Hon. Benjamin Butterworth, commissioner of patents. The manner with which the preparation and arrangement of the vast exhibits of the various bureaus have progressed insures a display that will appropriately and fully place the industrial life and immense mineral wealth of the country before the world.

The bureaus under the department of the interior which will contribute to the exhibit opened on December 16, 1884, are the Patent Office, General Land Office, Bureau of Education, Census Office, United Sttates Geological Survey (which includes the Bureau of Ethnology), and the Office of the Commissioner of Railroads. These exhibits will be ready for shipment to New Orleans in a few days. They will illustrate in a comprehensive manner all the important industries and interests in the United States.

The Bureau of Education will present in school architecture, models and drawings of schoolhouse structures, from the most primitive times up to the most improved building of the present day. Photographs and photo-lithographs will supplement the models and form a considerable part of the exhibit. The fixtures of the school-room, such as are used for heating, ventilation, and the modification of heat and light will be presented. The kindergarten will be shown with all the material which is used in that kind of a school, and a considerable amount of children's work. It is intended that this section shall be under the immediate supervision of an experienced teacher of kindergarten, and that much pains will be taken, not only with the kindergarten itself, but with the material for the instruction of young children.

Primary, grammar, and high school rooms will be fitted up with desks, apparatus, charts, maps, specimens of scholars' work, text-books, and any other material that may fairly represent the appliances found in our best schools. The college rooms will be similarly fitted up, and will be made to display, so far as possible, the contributions of colleges to the bureau for use in this connection.

Professional education, especially the teaching of medicine and dentistry, will be amply illustrated by charts, photographs, and plans of medical buildings; by the instruments used in the profession, and in such other ways as the ingenuity of the medical profession may suggest. The schools of science and technology are expected to contribute largely of their products to the section especi-

ally devoted to institutions of this character. Plans of bridges, buildings, and machines, and constructions of various kinds will form a part of the display of the schools of technology. The schools for the education of the deaf mutes and the blind and reform schools are to be especially represented by their products, coming not only from their school-room, but also from the shops which are frequently a part of these schools. A library room has been planned in which there will be found current numbers of the educational periodicals of the country; the most useful books for teachers; the various city, State, and national reports on education; specimens of foreign reports and periodicals, and other material of a similar nature.

The representation of statistics by charts will be largely shown in this room; the statistics of illiteracy will be presented by colored maps, showing the localities in which education has been most neglected. Physical and chemical laboratories have been planned by professors of these subjects, and will be so arranged as not only to display the apparatus illustrating the different departments of these sciences, but to show visitors some of the more common and useful experiments which are performed before classes in physics and chemistry. The manual training schools which have sprung up in the country since the centennial will be represented by the tools and machines which are used in these schools, and it is believed that under the management of a skillful superintendent the actual operation of these schools in teaching carpentering, forging, machine work, and the like, will be handsomely displayed. The schools of art of the country will be represented by their product, which will form a most interesting part of this display. It is believed that this bureau will make a most interesting and instructive exhibit to all who feel an interest in a more advanced stage of education.

The Census Office will illustrate by a series of illuminated charts and diagrams, together with some geometrical figures, the present stature of this country, and its growth by decades, as far as may be possible, in population, agriculture, manufactures, mining, forestry, fisheries, and other material interests. The present standing of the United States, as compared with foreign countries, will be indicated by a combination of figures and illustrations showing our relative population, industrial employments, and value of products, acreage and agricultural products, wealth, taxation, and indebtedness, with interesting comparative data relating to the defective and dependent classes of the people to their social progress, occupations, etc.

The Geological Survey comprises also the bureau of ethnology. During the last five years this bureau has made large collections of the products of aboriginal art, both ancient and modern, such as textile fabrics, pottery, implements of war and of the chase, with other curious objects, many of which were used in their periodical ceremonies and dances; these latter will be arranged by Mr. Frank Cushing, who is familiar with the mystic rites of these people, and will make an interesting exhibit. Col. James Stevenson has been in the far west during the past two or three months collecting important additions to these ex-

hibits, all of which will be displayed in the National Museum after the close of the exposition.

Among other objects of interest and wonder will be the series of models of the towns of the existing Pueblo tribes, and of the ruins, cliff-dwellings, and towns of the pre-historic peoples. An entirely new series of these has been made on a scale of one-sixtieth—large enough to show much of the interesting details of their architecture and habits of life. The model of the Pueblo of Zuni, the largest, is upward of twenty feet long. Appended to this display will be a number of models of the mounds, earthworks, etc., of the mound-builders. A series of the relics of stone, clay, metal, various tools and implements, and a representation of the skeletons obtained from the mounds. This branch of the work is under the special supervision of Prof. Cyrus Thomas, who has been engaged during the past four or five years investigating the origin and possible history of these unknown people.

The Geological Survey will furnish a number of models of the more important geologic and typographic features of the far west,—the Grand Cañon of the Colorado, the Yellowstone Park, the Yosemite Valley, and the grand district of the Rocky Mountains. There will also be a number of models of the great mines of Colorado, Nevada, and California.

A fine collection of the largest and most elegant photographs ever made will be shown by the transparencies, and will be an exceedingly attractive feature of the exposition. There will be 150 of these pictures which will illustrate chiefly the people and scenery of the far west. They will be returned to the National Museum after the close of the exposition.

There will also be sent from the United States Geological Survey specimens representing the ancient life of the globe, the fishes and reptiles of strange form, some of them of immense size, the multitude of remarkable quadrupeds which have become extinct, the infinitely varied forms of shell fish which have inhabited the seas of former geological periods, and remains of the mighty forest trees that once covered a large portion of the earth's surface, and which have been succeeded by those which now decorate the earth. This exhibit will include minerals of nearly every kind known to science, from the beautiful and costly gem to the common clay of the potter; ores of every metal known to human industry, representations of the mines whose wealth is fabulous, maps and charts showing the location of all this natural wealth, the extent and methods of its development, and giving plain indications of their future productiveness.

The space required for the exhibits of the interior department is as follows: For the Patent Office, 15,650 square feet floor and 1,800 feet wall space. Geological Survey, 10,000 square feet floor and about 1,500 wall space. Pension Office, 600 feet floor and seventy-five feet wall. General Land Office, 300 feet floor and 1,400 feet wall. Commissioner of Railroads, 2,000 feet wall space and floor space to view exhibits. Census Office, 300 feet wall and floor space to view exhibits. The total floor space required is 35,000 square feet.

THE NICARAGUA CANAL.

The President's announcement in his message that a treaty with the Nicaraguan government, which authorizes this government to build, maintain, and forever control a canal, railroad, and telegraph lines across that country, has already been concluded must be both surprising and gratifying to the commercial world. It is a surprise because the negotiations have been conducted to success before any one knew they were being pressed, and gratifying because no more important diplomatic enterprise could have been undertaken than that which has now successfully prepared the way for a water connection between the rich territory of the Pacific slope and the great parts of the Atlantic. From other points of view also the matter is one of great import to the nation.

One hundred miles of the projected enterprise may be reported as almost completed, as it is furnished by the San Juan river and Lake Nicaragua, which is forty miles wide and sufficiently deep for the purpose. The engineering difficulties to be overcome in the remaining fifty-three miles are not great. When this treaty is ratified the Panama question will cease to demand attention—if indeed it shall remain a question.

EDITORIAL NOTES.

THIS number of the REVIEW, like that of December, is conspicuous for its large number of articles by Western contributors. It is also in our opinion exceptionally good in the articles selected from other magazines. The ground covered by these articles is sufficiently wide to meet the wants and sufficiently popular to attract interest, and benefit almost all classes of readers.

We call particular attention to our offers to clubs, and also to the inducements we offer subscribers who desire to subscribe for other magazines.

THE great industries of America form the subject of a series of articles which will commence in the January number of *Harper's Magazine*, with a paper entitled "A Pair of Shoes," written by Howard Mudge Neuhall, a leading shoe manufacturer in Lynn. These industrial articles are planned to give, in readable fashion, a clear idea of how the important articles of industry are made, who make them, how much they earn, and how they live; in short, to inform Americans how they are clothed, fed, and otherwise served in these days of machinery, and how their fellow-Americans earn their respective livings.

WE have received from the author a copy of a new and interesting archæological work entitled "The Book of Algoonah," which attempts to throw fresh light upon the cloudy subject of the Mound-builders. We shall notice it fully in our next number, and in the meantime call attention to the advertisement of the work in this issue.

ITEMS FROM PERIODICALS.

THE January number of the *North American Review* is an excellent one. It presents no very famous names among its contributors,

but it offers a wide variety of unusually readable articles. We are now so safely over the crisis of the presidential election that men of all parties can consider calmly Bishop Huntington's essay on "Vituperation in Politics," and it is to be hoped that what they learn from it will not be forgotten four years hence. Under the title, "The Reunited South," Henry Watterson presents with great clearness the Southern and Democratic view of the political situation as it now stands. This also is extremely interesting to every citizen, whether he agrees with Mr. Watterson or not. Another question of universal concern, which some think will soon make itself a national issue, is that of labor and its compensation; and Col. Hinton, in "American Labor Organizations," shows with what equipment it will take the field. But the article that the literary reader will first turn to is Frederic Harrison's brilliant and incisive discussion of "Froude's Life of Carlyle;" while the religious or philosophical reader will find in Courtney's "Socrates. Buddha, and Christ," specific statements and quotations of those parallel doctrines that are so often vaguely alluded to. For the scientific reader, Mr. Proctor discusses learnedly "Herschel's Star Surveys," and Prof. Le Conte presents and explains some curious facts in relation to "The Evidence of the Senses." Mr. Mulhall's paper on "The Increase of Wealth" is a successful endeavor to render large masses of figures popularly intelligible.

FOR some months past prospectors have been at work on a coal shaft at St. Joseph, Missouri, having sunk it to the depth of nearly 1,200 feet. As we learn from the *Gazette*, they are now in a dark, oil-bearing sandstone formation and expect to strike oil or coal very soon. All the strata pierced have been found to correspond with those in the coal shaft at Leavenworth, though much thicker. So that the borers expect to find at about 1,235 feet the same vein of coal that has been so profitably worked in the former city at less than 800 feet.

THE *Atlantic Monthly* for January, 1885, starts off with a decidedly interesting table of contents: The Prophet of the Great Smoky Mountains, I, Charles Egbert Craddock. A Canadian Folk-Song, William Wilfred Campbell. Childhood in Greek and Roman Literature, H. E. Scudder. The H Malady in England, Richard Grant White. A Marsh Island, I.-III, Sarah Orne Jewett. The Christ of the Snows—A Norwegian Legend, S. Weir Mitchell. A Salem Dame-School, Eleanor Putnam. A Story of Assisted Fate, Frank R. Stockton. Madame Mohl, her Salon and her Friends—First Paper, Kathleen O'Meara. Winter Days, Extracts from the Journal of Henry D. Thoreau. A Country Gentleman, I.-III, M. O. W. Oliphant. The Star in the East, Harriet Prescott Spofford. The New Portfolio, Oliver Wendell Holmes. Vedder's Drawings for Omar Khayum's Rubáiyát. Culture of the Old School. Recent American Fiction. Studies of the Renaissance. The Contributors' Club. Books of the Month.

THE *Popular Science Monthly* presents the following table of contents for January: A Glance at the Jury System, C. H. Stephens. Agnostic Metaphysics, Frederic Harrison. Last Words About Agnosticism, Herbert Spencer. Influences Determining Sex, Prof. W. K. Brooks. My Schools and Schoolmasters, Prof. John Tyndall. Gladiators of the Sea, Frederik A. Fernald (Illustrated). Studying in Germany, Prof. Horace M. Kennedy. State Usurpation of Parental Functions, Sir Auberon Herbert. Bloody Sweat, J. H. Pooley, M. D. Protective Mimicry in Marine Life, Dr. W. Breitenbach. The Chemistry of Cookery, W. Mattieu Williams. Advantages of Limited Museums, Oscar W. Collet. The Architecture of Town-Houses, Robert W. Edis, F. S. A. Mountain Observatories. Sketch of Sir Henry Roscoe (with Portrait). Editor's Table: Harrison and Spencer on Religion; A Healthy Materialism; Politics and Science. Literary Notices. Popular Miscellany. Notes.

KANSAS CITY

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ENGINEERING.

KANSAS CITY CABLE RAILWAY.

There are now two cities in this country that have cable railways in successful operation, and very soon three others will be added to the list, New York, Philadelphia and Kansas City. The latter city can claim the first duplicate cable railway, the others having but one cable in the tunnel beneath the street for propelling cars. The distinction between a single and double cable in cable railways is what their respective names imply. In the ordinary cable railway, or single cable road, when accidents occur to the cable, such as loosened strands, broken wires or the cable is otherwise injured so as to affect its strength, to repair these injuries it becomes necessary to stop the operation of the road, thus causing a cessation of business which means a very great loss to the company, or which may be prevented only by continuing to use the fractured cable until the hour of stopping at midnight, which would cause still greater injury and perhaps ruin to the cable for further use.

In Chicago when serious accidents occur, the horses used on other lines owned by the company are pressed into service and made to haul the cars. Horses would be of little use pulling cars along the road in Kansas City, as the grades are so excessively steep that it would be impossible to ascend many of them. Should an accident occur, the public would have to wait until the repairing had been done but for the additional cable and machinery that is at all times ready for use at a moment's notice. The change from one cable to the other requires but very little time, and the travel is not interrupted. The duplicate

road has a duplication of machinery throughout. Besides the cables there are two carrying pulleys side by side that support the cable in every pulley-pit, which are thirty-five feet apart along the road; at the extreme ends of the railway, where in the ordinary cable road there is one sheave twelve feet in diameter, in the duplicate road there are two. This duplication is still more extensive in that two independent sets of driving machinery are provided in the engine-house, also engines, boilers, etc.; in fact, the provision made in the way of machinery is sufficient to build another and independent road; thus the cost is very considerably greater than in the case of a single cable railway.

There is probably no cable railway in the country, that in constructing presented so many difficult features to be overcome as the Kansas City road. The wrought-iron elevated structure from Union Avenue to the top of the bluff does not represent all the work done at this end of the road. At Union Avenue large and massive brick foundations were built pyramidal in shape. Old sewers were encountered requiring special provision to overcome these unexpected obstacles. At the bluff very serious difficulties presented themselves. In locating the foundations for the wrought-iron supports for the viaduct it was discovered that a local movement in limestone ledge was taking place. A great portion of earth and loose rock deposited at the base of the bluff was removed, exposing the rock ledge in question five feet in thickness, underneath which was a stratum of soapstone and bituminous shale eighteen feet in depth, which disintegrated rapidly and thus allowed the rock ledge above to fall in large fragments to the base of the bluff. The rock ledge was cleared of earth and other materials, and all the cracks or fissures located, which were then thoroughly cleaned out and filled with liquid cement grout made from German Portland cement. When the cement had set it excluded all water from springs and surface drainage from the base of the rock, which before served as a lubricant to the moving ledge. The shale and soapstone were further protected by building a stone wall in front of the vertical face of the stratum, close to it; the space between the wall and shale was then filled with concrete and cement grout, thus excluding air and water from the exposed face of shale; the rock ledge was thus made solid and permanent, no further movement having been discovered. The process of disintegration of the shale was watched with considerable interest. It was noticed that so long as the shale contained some moisture, or the water was allowed to saturate the surface, disintegration was retarded, but when the sun caused the shale to become dried and warm, the absorbed air seemed to expand, thus throwing off small particles of shale, which would have continued until the whole ledge had fallen but for the protecting wall and the concrete excluding the air.

The wrought-iron viaduct will, when completed, present a very interesting piece of work. The incline down the bluff is eighteen and three-tenths feet in 100 feet and commences at the west line of Jefferson Street with an elevation of 191 feet and descends westwardly, at the rate mentioned, to the center of the main span across the Union Depot yards, the length of which span, from end-pin to end-pin, is 186 feet. The incline commencing in the center of this span,

and ascending with the rate mentioned, caused a curious modification in the design of this bridge from ordinary bridges. The end posts were made to incline so as to cover two panel lengths of the bridge, thus providing sufficient clearance between the portal bracing and top of car, which could not have been secured had only one panel length been covered by the end post as is usual.

From the centre of this span westward to Union Avenue, the tracks are level, beginning at this point to ascend at the rate of two feet in one hundred to and by the waiting station. The waiting station is quite an ornament of its kind. Stairways descend to either sidewalk of Union Avenue, and are covered and protected from the weather. The roof of the main waiting room projects over the platform on all sides, and is covered with slate. A passenger wishing to take a train up the incline to Main street pays his fare to the agent, who gives a ticket in return, which is collected on the train. He passes through the waiting-room to the train. Passengers coming from the trains pass to the passage-way on either side the building, through the gates to the stairways. The trusses across Union Avenue are sixty-five feet in length and eight feet in depth, and three in number, that support the waiting-room and tracks, which trusses are in turn supported by wrought-iron columns, three on each side the Avenue. These columns are inserted into heavy cast-iron shoes or bases, extending into the casting about two feet. The space between the cast socket and column was filled with cement grout and is now equal to rock in hardness. There are two large sheaves, twelve feet in diameter, over the Avenue, supported between the girders, weighing four thousand pounds each. The main bridge span at Union Avenue is supported by two wrought-iron columns, one under the end shoe of each truss. The distance from the railway tracks below the bridge to the floor is twenty-three feet, and the distance from the floor of the bridge to the upper chord or top of truss, is twenty-six feet. The iron work at this end of the road is composed of eleven spans and they have the following lengths, commencing at Union Avenue: 65 feet, 185 feet, 67 feet, 29 feet, 45 feet, 46 feet, 47 feet, 46 feet, 46 feet, 47 feet, 47 feet. At the end of the last span the cable leaves the open work of the viaduct and enters the concrete subway below the street. The rails of the tracks on the viaduct at one point are about fifty feet above the surface of the ground below. The railway is double-track throughout. There are several steep grades on the line, but none greater than the viaduct grade. There are two curves, both at street intersections, at right angles to each other. A special and independent sewer has been constructed from one end of the road to the other, between the tracks, which connects with the regular city sewers at every street crossing. The carrying pulley-pits are made of brick twelve feet by five by five feet in depth, extending under both tracks in its longest dimensions. They are large and spacious. Two cast-iron pulley frames are arranged at each side of the pit corresponding with each track. Communication is had with the pit by means of a heavy trap door between the tracks.

The cable in passing around the curves at Grand Avenue occasions great resistance. The constructions at the curves consist of a series of horizontal

conical pulleys, there being three independent pulleys on each shaft, which constitute a set. The lower one is a large conical pulley having a groove at its base in which the idle cable rests, the next above this is an ordinary horizontal grooved pulley in which the moving cable rides. The next and upper pulley of the set is a plain pulley with a smooth rim against which the grip rests and by which it is guided around the curve. The cable passes from the engine-house to the sub-way below the street and under the south track, thence to Woodland Avenue, around twelve-foot end-sheaves, thence into the sub-way below the north track to Union Avenue, around the twelve-foot sheaves over Union Avenue, and thence to engine-house, around the driving drums and thence to the tension-car wheel, or sheave.

The grip-cars are radically changed from those in use on other roads, in that the grip is operated from the end of the car instead of in the centre, consequently the gripping attachments occupy very little room in the car. A complete cab is provided at each end of the car in which the grip-man is stationed and operates his grip without being interfered with by passengers.

The grip consists of three parts—the upper or crank part, the middle or shank, and the lower or jaws. The upper is made from cast-steel, and so constructed as to embody great strength; the crank and shaft giving motion to the jaw of the grip are connected at one side, this part with the levers of the grip-wheel in the cab, which crank is also connected with the central and moving part of the shank, which has a vertical motion; the moving part of the shank is also connected with the movable and horizontal upper jaw of the grip, the shank being made from rolled-steel and the jaw of cast-steel lined with brass, reducing the wear on the cable to a minimum. The lower jaw of the grip is stationary, having two rollers placed vertically at each end of the jaw. When it is desired to start a car the grip-wheel in the cab is turned to the right, which forces the movable upper jaw (seventeen inches long) down on the cable resting on or rolling over the pulleys in the lower jaw of the grip; the pressure forces the rollers down a limited distance with the cable; as they are supported by flexible journals, the brass in the grip takes hold of the cable under the pressure of the grip-wheel and the car moves. If it is desired to stop the car, the grip-wheel is turned to the left, thus raising the movable upper jaw from the cable. The pressure being released, the small pulleys in the lower jaw spring upward slightly and support the cable, revolving at the same time, and while the car is thus stayed, receiving or discharging passengers, the cable continues to move through the grip between the jaws supported by the pulleys referred to. It does not matter how often stops are made, the cable never leaves its position between the grip's jaws—it is either gripped by the jaws or riding on the pulleys in the lower jaws. The cable is, however, conducted out of the grip when it is necessary to change the car from one track to another, and in passing over the vault on the south track at the engine-house—there being no cable at this point, as it is conducted into the engine-house too far below the street for the grip to reach—the cars are carried

over this distance, which amounts to forty feet, by momentum acquired from the cable before reaching the vault. This occurs on the south track only.

The cable is one and one-quarter inches in diameter, made from Swedish iron wire. It is capable of resisting a strain of thirty tons. There is a total length in both cables of forty-four thousand feet. It is expected that this cable will have to be replaced within eighteen months from the opening of the road.

Many people have been at a loss to know how the cable is prevented from impinging against the upper side of the tube or tunnel below the street in the depressions along the line, and at points where grades change from a level to a comparatively steep grade. It must be remembered that the cable is very much heavier than a string, its weight being two and a half pounds per lineal foot. When the ordinary tension is on the cable and an average number of grips with their loaded cars attached are being propelled by it, the deflection between the carrying-pulleys, which are thirty-five feet apart, is about two inches. It would be impossible with any power to cause the cable to assume a straight line from one hill to the other, and before the *sag* or deflection could be gotten out, it would break in two. The cable leaves the engine-house with a strain of about one ton and returns to it with about five tons (approximately), doing its maximum work, and the total weight of one cable is about twenty-eight tons, Where it is necessary at the depressions referred to depression-pulleys are placed which hold the cable down, and when the grip passes the cable is pressed down six inches below these pulleys; thus the grip avoids contact with them.

The maximum grades on various roads are as follows:

Clay Street, San Francisco	16 feet	in	100 feet.
California St., "	18 "		100 "
Suter St., "	8.7 "		100 "
Geary St., "	9.8 "		100 "
Ninth St, Kansas City	18.3 "		100 "
Chicago City, State St	(about level.)		

The power developed in operating cable railways is usually proportioned as follows:

For moving cable	51 per cent.
For moving cars	46 "
For moving passengers	3 "

The power-station or engine-house is located at the corner of 9th and Washington Streets, and has a frontage on the latter street of ninety feet and on the former of 144 feet, two stories and basement. The east room is the boiler-room, and is separated from the engine-room by a brick partition wall; the floor is thirty-two feet below the street grade. One battery of boilers, after the Ferminicle patent, twenty feet in height, occupying a floor space of twelve feet by twenty feet, have their fire fronts facing 9th Street. The boiler settings are especially attractive, being laid up with Philadelphia pressed brick, with a bold projecting

cornice. In the use of these boilers there is no danger from disastrous explosions, as is the case in the use of ordinary tubular boilers. At the base on either side and a little below the grate-level are two large plate-iron mud-drums, the upper sides of which are framed with a horizontal plate, into which the water-tubes are expanded; the tubes are sixteen feet long and three and a half inches in diameter, and are placed in an inclined position, the ends being expanded into the lower horizontal plates of the upper water drums. There are two of these drums in each boiler corresponding with the lower mud-drums, the tubes in these drums incline towards each other as they extend upward to the water-drums above; above these drums the steam-drum is located, connected with the upper drums referred to by means of two wrought-iron legs six inches in diameter. The water circulates through the tubes, the heated gases passing around and about them. In the case of low water there is no danger of explosion save from the three and a half inch water-tubes, which would result in no serious damage should any explode.

Immediately back of these boilers is located the smoke-stack, and south of this again is another battery of boilers. The smoke-stack pedestal is eighteen feet square, and the total height of the stack 150 feet above the boiler-room floor, the flue is five feet in diameter, having an iron ladder fixed at one side of the flue from the base to the top of stack. Directly west of the stack and against the wall, is arranged a large heater with pumps and other necessary parts. The heater containing water has a height of twenty feet and is fifty inches in diameter, having inverted (∩) U-shaped brass tubes. On either side the heater are Worthington Duplex Pumps, each having a capacity of 8,000 gallons per hour. The exhaust steam-pipe from the engines conducts the steam to the heater, which then passes through the inverted U-shaped brass tubes in the water in the heater, thence by the exhaust-pipe out of the building.

It will be seen that in this, as in all heaters, the steam after having performed all the work required of it in the engines in turning the machinery, is conducted through the heater, thus heating the feed-water to a temperature of about 280°; when it is forced by the pumps into the boilers. It is generally claimed that fifteen per cent of fuel is saved by using a good heater over the practice of forcing cold water into the boilers. The total boiler capacity equals six hundred horse power.

The engine-room, which is twenty feet above the floor of the boiler-room, has the appearance of some large pumping-station. There seems at first glance to be a confusion of large drums and gear wheels which, upon closer examination, assume right positions and perform each their respective work. To those expert in mechanical construction it presents a very complete and well arranged piece of accurate designing, nicely proportioned parts, and upon the whole a model plant for the purposes for which it was designed. There are two large automatic cut-off engines quite near the door through which you pass in entering from the boiler-room. The cylinders are 24x48 inches. The engines throughout are highly finished and were built by William Wright, of Newburgh, New York. In place of the ordinary crank, large and highly-polished circular discs are arranged,

which add much to the engines. The engines combined are equal to five hundred horse power.

The engines are about twenty feet apart, having a common shaft thirteen and a half inches in diameter. On the end of the shaft nearest the east engine the large driving-wheel is fixed; it is eighteen feet in diameter, weighing 34,500 pounds. A very heavy and substantial pillar-block supports the shaft between the fly-wheel and the large gear on engine-shaft. This gear has an eighteen inch face, and is geared into a large gear ten feet in diameter, keyed on the main-line shaft of driving machinery. A very heavy cast-iron girder-frame surrounds the gear referred to. The main-line shaft extends westward across to the girder-frame of driving machinery. This frame entirely surrounds the driving machinery and is eighteen inches in depth and seventeen inches across the upper face. Between the two outside parts of the girder-frame there is arranged a central piece running north and parallel with the outside frame. On each of these three parts of the girder-bed or frame of the machinery, and supporting the main-line shaft, are heavily proportioned pillar blocks. Next the two outside pillar blocks the five-foot gears of the machinery are keyed on a sleeve on the main shaft, which shaft revolves in the sleeve, each of which have a sleeve arranged on their inward side. In these sleeves eight steel circular plates are permanently fixed. Another sleeve is keyed on to the main shaft, which also has eight circular steel plates arranged which revolve with the shaft, but which are worked laterally on a key in the shaft. When the sleeve is moved inward with its steel plates, the plates take up against the steel plates in the sleeve on the gear, causing frictional contact, which is gradual but positive, and when the plates are brought together with sufficient pressure the gear revolves with the main driving-shaft. These gears are connected with a series of gears, which cause the two driving drums twelve feet in diameter of each set of driving machinery, around which the cable passes, to revolve. The central piece of girder frame separates the two sets of machinery, either of which is set in motion or deprived of motion by means of the lever connected with their respective clutches described above. These clutches are known as the Weston Clutch and are the largest of the kind applied to this class of machinery.

When accidents occur to the cable and it is desired to repair it, the clutch belonging to that particular set of machinery is released, and the other is forced against the gear plates of the other set of machinery; thus the other cable is set in motion, doing the work of the injured one until it is repaired. The injured cable is then, by means of auxiliary engines, slowly led into the engine-room where the repairing is done.

These auxiliary engines, especially designed for this purpose, were built by the New York Steam Engine Company. The driving machinery was made by Poole & Hunt, Baltimore, who have a national reputation for manufacturing the finest gears and machinery of this character.

Back of each set of driving machinery there is a track built which extends five feet above the floor of the engine-room, and supported by a series of brick

arches. Upon this track a car moves back and forth, moved back by means of heavy weights in a pit at the back part of the building connected with the car by means of a cable over a vertical pulley at the pit, moving forward as the increased tension on the cable in the street demands, caused by additional cars using the cable. There is arranged also in the center of this tension-car a large twelve-foot sheave which constantly revolves as the cable passes around it, in going from the driving-drum to the sheave and out into the street again. The gauge of the tension-car track is three feet. In front of the engine-house on 9th Street a very large vault is made under the street; the roadway at this point is carried by iron columns. This vault has six large twelve-foot sheaves arranged in it, each of which weighs 4,000 pounds; these are used for directing or guiding the cables in to the engine-house.

The room next west of the engine-room is arranged as a machine shop; it is large and provided with such tools as work of this kind requires.

The 9th and Washington Street floor is used as a storage-room for cars, in one corner of which is provided a very complete wash-room for cars, heated in winter with steam radiators, and also provided with hot water.

The upper floor is used as a paint and-repair shop, except that portion partitioned off for offices. These offices are all finished with Southern pine, there being in all six rooms; namely, conductors', superintendent's, cashier's, directors', and civil engineer's office.

The total length of this road, as now built, is two and one-quarter miles. Next summer the road will be extended eastward one mile on Independence Avenue, and one mile on 9th Street. Mr. Robert Gillham, C. E., chief engineer of the company, has his plans of these extensions nearly completed. Plans are also being prepared by Mr. Gillham, who is also chief engineer for the Inter-State Rapid Transit Company, who are about building an elevated cable railway from Kansas City to Wyandotte. The total length of this road, including the proposed surface cable railway through Wyandotte, will be three miles, making a total length of double track, when these extensions are completed, of seven and one-quarter miles, all of which road will be operated by the machinery and the cable that operates the Kansas City Cable Road, described above.

There has been very little reliable information gathered regarding the economy and the power required under different conditions of loading of cable, to operate these roads. While it is true that cable railways have been in operation in San Francisco for several years, no scientific records or tests have been made; thus the results are not very well determined.

Mr. Gillham has provided means of testing the capacity of boilers, power of engines, evaporation of water per pound of coal, power required to move cable, machinery and cars; also to test power required in ascending the various grades, and to test the tension on cable under all conditions of loading. The information gathered from careful tests of this character will be of value to the engineering profession.

ANCIENT AND MODERN ENGINEERING AND ARCHITECTURE.

DR. R. WOOD BROWN.

The remark, "there is nothing under the Sun," is more axiomatic than the casual reader believes. We think that this is a very progressive age and that our generation stands pre-eminent in civilization—is the highest known. This is so, but to state that we, in this age, are immeasurably superior to the ancients is, we think, incorrect. Our aim is not to prove our century inferior to the past ones, rather it is to present historical facts which will indicate that mordern architectural and engineering works are merely reproductions of those of the ancients, though sometimes larger and more speedily erected, owing to better facilities.

The works of long ago compare very favorably with those of the present, and in some instances excel anything of our own time. Hardening copper for tools is one of the lost arts; we cannot manufacture the Damascus blade, nor do do we know by what means the pyramids were erected. There are very few (if any) streets like one in Cordova founded 152 B. C. It was perfectly straight, ten miles long and illuminated by public lamps. Paris, which is said to be the best lighted city in the world, cannot surpass this wonderful street. Cordova was not without rivals. Granada, founded before Augustus; Seville in its prime 590 B. C.; Toledo taken by Maximus Flavius 193 B. C., vied with Cordova with its 200,000 houses and 1,000,000 inhabitants. This city of Cordova may not be a fair comparison, as its decay commenced when conquered by Ferdinand III. of Castile in A. D. 1236. Modern cities surpass the ancient in number rather than in magnificence.

A slight acquaintance with archæology is sufficient to show us that the Statue of Liberty Enlightening the World is a duplicate in principle of the Colossus of Rhodes. The former is to be erected upon Bedloe's Island in New York Harbor, in honor of fraternity between France and the United States. It is of copper and the ascent to the head is made by inner stair cases. The right arm is extended, grasping a torch which will illuminate the harbor by electricity. The total height is 328 feet 11 inches, pedestal 177 feet 9 inches, leaving 151 feet 2 inches for the statue. This work of art was fabricated in France under the supervision of its projector, Bartholdi, who, in all probability took his idea from the Colossus of Rhodes, which was also erected upon an island, the Rhodus, in the Mediterranean Sea twenty miles from Lycia on the south coast of Asia. This Colossus was of brass, and erected 300 B. C. in honor of Apollo. Historians tell us that the height was 125 feet, "with legs distended on two moles which fromed the entrance of the harbor," said moles supposed to have been twenty feet apart, and ships sailed under the body on entering the port. The statue was hollow and the legs were lined with large stones to counterbalance the weight. This Colossus was the workmanship of Chares a pupil of Lysippus, a celebrated sculptor of Greece.

The Colossus of Rhodes was thrown down by an earthquake sixty years after erection. The brass made 900 camel-loads, or 720,000 pounds.

The Washington Monument, is considered a grand work, but the work of putting a new foundation under the old one was far more wonderful than the building of the obelisk itself. (See Kansas City REVIEW OF SCIENCE AND INDUSTRY, January, 1885, page 501). This monument presents a smooth exterior and is 555 feet in height; was commenced more than thirty-six years ago and finished under Colonel Thomas Lincoln Casey, chief engineer and architect, December 6, 1884. This pile of stone is hollow and capped by marble with a conical apex of aluminum. The Pharos of Alexandria was 450 feet high and built upon an island. Alexander the Great gave his order for this structure 332 B. C. to a Macedonian architect, Dinocrates by name, who also connected the island with the mainland by an earth wall. This light-house differed from the Washington Monument in being highly ornamented, the stone was finely carved, columns and balustrades worked in the finest marble embellished the exterior. It was built in several stories, tapering towards the top. The ground floor and the two next were hexagonal; the next square, with towers at each corner; the fifth to the top was round, with an exteral winding staircase. The extreme top was open so that sailors could see its night beacons. The Pharos at Alexandria was a work of art, a credit to Alexander who commenced, and to Ptolemy Philadelphus who finished it. The Americans have built the highest structure known to man, but it is barren of all art. There is quite a difference between building a lighthouse with carved marble on an island, and erecting huge stones perfectly smooth by machinery, inland, even to the height of 555 feet.

Both ancient and modern engineers and architects considered height as a great objective point. The great Pyramid is 478 feet. Cologne Cathedral is 510 feet. Rouen Cathedral 490 feet. The statue of San Carlo Borromeo, at Arona, erected in 1697 was 66 feet high and the pedestal 40 feet. A marble statue of Nero was said to be 120 feet high. The walls of Babylon were 378 feet high, also 93 feet 4 inches thick and in compass 60 miles. Herodotus, who was at Babylon, gives these figures; others give the height 50 feet as they were after the time of Darius Hystaspes, who pulled them down to that height, that he might conquer the city again more easily, if necessary. The Chinese wall was much longer, being 1,250 miles, but very much inferior in width and height; only 20 feet high, 25 feet wide at the base and 15 feet at the top; about one-third of the wall of China is dirt and rubbish, the rest being masonry, and it dates back to 220 B. C.

The Hanging Gardens of Babylon were built by Nebuchadnezzar to gratify his wife Amytis. The gardens were over 400 feet square, built terrace above terrace until they were 27 feet higher than the walls, or 400 feet. The top was sustained by a series of arches one above the other and each terrace was bound by a solid wall 22 feet thick. On the top arches were first laid flat stones 16 feet by 4. over these weeds and bitumen; then two rows of cemented brick covered

by sheet lead, upon which was laid earth sufficiently thick to nourish large trees. The gardens were filled with the blooming plants and shrubs which were admired by Queen Amytis in her native Media. The different terraces and groves contained fountains, parterres, seats and banqueting rooms; in fact all the splendor and magnificence of eastern art seem to have been lavished upon these gardens by King Nebuchadnezzar in order that his Median bride should be happy in her new home. Pen cannot picture the grandeur of the conception or the perfection of the execution of these gardens, which have been and are the wonder of all ages. The greatest hanging structure now in existence is the Brooklyn suspension bridge, costing $15,000,000. The whole length is 3 475 feet, and it connects New York and Brooklyn by a clear span of 1,595 feet. It is 135 feet above low-water mark and 85 feet broad, it has also two platforms, one above the other. The piers are stone masonry, hollow and sunk below the surface by means of caissons. As the details of this work are formidable it is sufficient to say that it is the greatest engineering feat known. John Roebling was the engineer.

One of the mysteries handed down to us is the manner in which the ancients manipulated these immense stones. Take the obelisk of Luxor, which stands sentinel over the Place de la Concord, in Paris, seventy-three feet in length. Long-continued manual labor could quarry it, but by what means it was conveyed to Luxor is still hypothetical; and the stones of the Pyramids, not one of which is less than thirty feet long by five thick, how could they be hoisted up 478 feet, or rather, how were they, and by what means were these great blocks of granite transported from the quarry at Syene to the delta of the Nile, a land journey of six hundred or a voyage of seven hundred miles? Egyptologists have surmised many ways by which the Pyramids were built, but none of them seem satisfactory. No representations of derricks or hoisting machines have been bequeathed to us. Some writers say that the stones were raised by machines from step to step, others tell us that skids were used, still others that the external covering was laid from the top to bottom. The great Pyramid Cheops covers at base about 550,000 square feet and rears itself 478 feet. The first step is nearly four feet eight inches high, the top one one foot eight inches. Mathematics were known in that day, as its angle was perfect at all sides 51° 50′, also each stone was accurately fitted to another. Notwithstanding the difficulty in finishing granite the stones of this royal tomb were finely polished. Chronologists differ as to the date of the reign of Cheops, the latest date given being 2123 B. C. Herodotus says that he "was informed by the priests of Memphis that the great Pyramid was built by Cheops, that 100,000 men were twenty years in building it, and that the body of the king was placed in a room in the bottom of the Pyramid." No king ever had a mausoleum so beautifully magnificent; beautiful in its simplicity, magnificent in its proportions. The Pyramid of Aphren is 684 feet square and 456 feet high. The Pyramid of Mycerinius is 330 feet at base and 174 feet high. There were many other pyramids built, but to all of them we can only say "the eternal pyramids—the mystery of the past—the enigma of the present—and the enduring for the future ages of this world."

We have never felt the feebleness of our descriptive powers so keenly as in the preparation of this paper. We have seen some of the works of the past, and their impressions can never be obliterated from our mind. We have seen the magnificent Cathedral in Milan, have seen the sun's rays reflected from its white marble, towering up 358 feet; we have watched day after day the light and shadow creep over its 10,000 statues, 1,500 bas reliefs, and its 136 spires. We have wandered over its variegated marble floor 486 feet long and 288 feet wide, and have climbed wearily to the top, yet we have no power of description—no delineation can convey our ideas adequate to the effect in viewing this stupendous church, begun in 1387, March 15th, and yet unfinished, costing so far $110,000,000. The Temple of Diana, at Ephesus, has been graphically described by archæologists and we cannot do better than to gather bits of their brilliant pen pictures. The original object of worship in Ephesus was a small statue of Diana made of ebony and believed in those days to have been sent down from heaven by Jupiter. A temple was erected to contain this image and completed during the reign of Servius Tullius 570 B. C. This temple was said to have been destroyed by fire. A second one was commenced about 540 B. C. exceeding the first in splendor, and this was partially burned on the day Socrates drank the hemlock 400 B. C. After having been restored with greater grandeur it was again partially burned 356 B. C. on the night Alexander the Great was born. Materials saved were sold, women gave up their jewelry, and contributions were sent from all parts of Asia, amounting to an immense treasure, and thus the Temple of Diana was restored in all its magnificence. Pliny says "that to secure the foundations of the conduits and sewers which were to support this structure, there were laid beds of charcoal, well rammed; over them wool; and that 220 years elapsed before this grand temple was completed." It was 425 feet in length and 220 in breadth, supported by 127 marble Ionic columns sixty feet high, of which thirty-six were richly sculptured and the rest highly polished. Each column was a gift of a king. The building and courts were encompassed with strong walls, there was a court on each side of the temple which was built upon a series of narrow arches one within another. The site being a morass, the foundations were said to have cost more than the superstructure. This magnificent work of art is no more, but if we should visit Constantinople we would find the Church of St. Sophia raised upon some of these columns given by kings to the goddess Diana. Justinian also filled Byzantium with statues from Ephesus.

One thing the ancients did not attempt; at least there is no record of their building self-supporting domes prior to the church of St. Sophia, in Constantinople, originally built by Constantine, destroyed by fire, and rebuilt by Justinian. The dome is 175 feet high. St. Paul's, London, commenced in 1675 and finished in 1710, has a dome 145 feet in diameter, and 365 feet from the ground. St. Peter's has the largest and highest dome known. This beautiful pile was commenced in A. D. 1450, and finished three and a half centuries after. The dome is 405 feet from the pavement and 193 feet in diameter, The domes of the churches of St. Genevieve and Invalides, Paris, are also self-supporting.

Not even Dinocrates, who built Alexandria and the Pharos, also the Temple of Diana, attempted the difficult engineering feat of self-supporting domes. In constructing the Pyramids mathematics were known, consequently it was not ignorance which prevented the ancients from worshiping under a self-supporting vault.

The sewers of Paris are great works of skill, large enough to float inspection-boats, but they do not surpass very much the Maxima Cloaca of Rome, thirteen feet broad and thirteen feet high, built by Tarquinius Priscus, 616 B. C. Athens had sewers which drained into the Saronica gulf. Babylonian sewers drained its marshes into the Euphrates. Modern age has simply copied from the ancient. The priñciple is the same now as when the Alexandrian architect wished to build a temple to Arsinoe, in which he intended to suspend her statue by means of a lodestone. The only thing modern sanitation can claim over the ancient is sewers greater in length and number, owing to the greater needs.

Of aqueducts, the Croton of New York claims the honor of being the finest of our age. It is forty-two miles long and thirty-three from Croton lake to Harlem river. Lisbon aqueduct is twelve miles long; the one which carries water to Paris 110 miles. Ancient Rome had fourteen aqueducts. Three of these supply modern Rome, Aqua Virgo, about eleven and a half miles, built by Agrippa, to supply his baths. Aqua Claudia, forty-five miles long, and Aqua Trajana, twenty-three miles, built to supply inland basins for spectacular sea fights. Constantinople had its aqueduct of Pyrgos fifteen miles long. The aqueduct supplying Athens had perpendicular pipes of clay or lead every 240 feet or so, leading up to the surface; by this contrivance light and air were admitted to the water. Eupalinus tunneled through a hill at Samos eight feet high, eight feet broad, and four thousand two hundred feet long, with an accurately-reckoned declivity; also a channel at the bottom, three feet square, to carry the water, which was thereby aerated. Duplication of tunneling on a greater scale is found in Mt. Cenis eight miles long, double tracks. It is twenty-five feet wide at the base and twenty-four feet high. St. Gothard is nine and a half miles long. Hoosac is 25,040 feet, and Sutro 3.84 miles long. The last clearly parallels the Samos tunnel, being used to carry water from a mine. Some writers say that the Euphrates was tunneled under, but the statement is vague and bears no authenticity.

The reservoirs of the ancients were not inferior to those of the present time. The expertness of the ancient engineers is attested by the remains extant; they certainly are not buried in the waters of the Lethe. The Pools of Solomon still continue to furnish water to Jerusalem. They are three in number. The upper is 160 feet above the middle one, the latter 248 feet above the lower. The first was supplied by pipes from springs, and, when full emptied into the second and that into the lower one. The water was used for irrigating Solomon's gardens and supplying his temple. The lower pool held about 31,442,425 gallons, the middle about 12,289,912, and the upper one contained 13,778,772—a grand total of 58,511,109 gallons, or nearly six times as much as the Kansas City reservoir, which is estimated at 10,000,000 gallons. These pools were solid rock and

masonry, lined with cement, and had steps leading to the bottom. One historian says that Nebuchadnezzar, wishing to brick the bottom of the Euphrates, which flowed through the center of Babylon, caused a reservoir forty miles square to be dug so as to allow his masons a dry river bed. Another historian writes that Nitocris, a daughter of Nebuchadnezzar, is said to have dug a reservoir 420 stadia in circumference, lined with stone, for the waters of the Euphrates, in order that the river-bed at Babylon should be dry so that she could build piers for a bridge. A stadium being 625 feet, it would make this circumference forty miles. These two reservoirs may be the same, and this shows what discrepancies there are among writers.

The melting snows from the Armenian mountains sometimes caused an overflow of the Euphrates, whereby the city of Babylon and the country surrounding suffered from inundations. It was therefore necessary to drain the country, and to prevent any future trouble two canals were cut west from Bossippa to the river Tigris, which makes these canals about seventy-five miles long. Ancient Greek authors attribute this work to the ruler who made the greatest city of ancient times and one never excelled in any age—Nebuchadnezzar. There are many canals now of modern engineering, but few, if any, constructed to drain and to receive waters from overflowing rivers. The longest canal is the Erie, in New York State, 350½ miles long and 70 feet wide, finished in 1862. The largest canal is the Suez, authorized by Said Pasha in 1854, built by M. Ferdinand de Lesseps, and finished, or rather, officially opened in 1871. It is 100 miles long, of which 25 miles are lakes. Its width varies from 325 to 197 feet at the top, and is about 70 feet wide at the bottom; the depth varies from 30 to 85 feet. The Erie canal entire cost nearly $46,000,000, while the capital stock of the Suez company was $60,000,000. The United States leads all other nations in number of canals—forty-four altogether.

The length of this paper forbids our writing further, although the archæological fields are blooming with undescribed beauties of art. Many more comparisons could be made which would place the modern age in an unenviable position. Readers who have been our companions so far will notice many so-called errors, but when it is borne in mind the large number of historians and archæologists, also the difficulty of deciphering the writings of those whose sarcophagi have been violated, it will be apparent that dates and measurements, at the best, are merely approximate.

KANSAS CITY, MO., January 21, 1885.

UNDERGROUND WIRES.

Representative Bond of St. Louis has introduced in the Missouri Legislature a bill providing for the removal of all telegraph, telephone and electric light wires from poles and buildings to channels under ground.

It provides that no person or persons, or company, or corporation shall be

allowed to erect or maintain on telegraph poles, piers, abutments, wires or other fixtures upon, along or across any of the public roads, streets, and alleys of any city having a population of over 100,000 souls. The companies will be given one year after the passage of the act to take down their poles and wires, the penalty for the maintenance of such after that time to be the payment of $1,000 a day into the State Treasury until the poles and wires have been taken down. Mr. Bond says that wires are now being put under ground in Chicago, as they have been in New York and Philadelphia, and that his bill will be similar to the one passed by the New York Legislature, and decided as valid by the Supreme Court of that State.

We find in the *Globe-Democrat* the following article, which doubtless expresses the popular feeling upon this subject:

New York has a law ordering that all telegraph, telephone and electric light wires in New York City and Brooklyn shall be put under ground by the 1st of next November, or else be torn down by the city authorities. The passage of this law last spring filled the managers of the electric companies with consternation, and they have from time to time been loud in their protestations of inability to conform with the order, though professing themselves to be only too anxious to have some feasible method of doing so. The honesty of these declarations receives a severe shock now from two eminent experts in electricity. Prof. Bell, who invented the telephone, not only believes that every city ought to insist upon the burial of telephone wires, but says that the service would thus be greatly inproved; while Sir William Thomson, in an elaborate report upon the telegraph service, affirms as the result of his experiments that "there is no doubt whatever that any amount of traffic could be worked through a system of underground wires at the usual rates of hand sending." Nor, he adds, "is it any more difficult to work lines composed partly of underground and partly suspended wires. The cost of maintaining underground wires would compare favorably with that of aërial lines, though the first expense would of course be vastly greater. But, on the other hand, "underground wires will be almost free from interruptions due to storms or to extremes of heat and cold, whereas aërial lines, however well constructed, must always be subject to injury from wind, snow and extreme cold."

These opinions are worth emphasizing because the subject is being mooted in almost every city of importance in the land, and is everywhere met by the electric companies with the same profession of helplessness. Of the desirability of the change there can hardly be two opinions. The forests of wires which fill many of the streets of every city are not only an offense to the sight, but a source of annoyance and frequently of danger. They present one of the confessed hindrances to the best efficiency of the fire department service, and in the case of electric light the wires are a constant menace to property and life. Cases of death and of the burning of buildings from contact with the electric light wires are not unknown and electricians have testified that this danger is by no means small. A storm which throws the wire to the ground might easily make it an instrument of death; a stream of water from a hose-pipe striking an abraded insulation

might kill a fireman; or a wet flag-pole jutting out from a house might serve as the conductor for a devastating current. In fact, security in the case of the electric light wire, depends upon keeping intact a slight covering that is swayed by every breeze.

The subject is, however, one of indisputable difficulties, particularly in cases where, as in the telephone, single wires are conveyed for considerable distances, and the income from them is of necessity small. To insist that every telephone wire shall be placed underground would, under existing conditions and until this modern luxury is much more generally enjoyed, frequently amount to prohibtion. It is becoming a serious question, too, how far it is advisable to carry the system of underground communications in the streets. What with sewer, water, gas and steam pipes, the streets of many cities are being pretty constantly dug up, to the obstruction and even prevention of the travel which is their principal office. Perhaps the solution of this complex problem may one day be the adoption of a general and uniform system of underground communications, like a common subway which shall contain all the appliances for distributing heat, gas and electricity, and shall be of sufficient size to permit of ready access for additions or repairs. The cost of such a system would, doubtless, be very great, but it would settle the problem once and for all.

GEOLOGY.

THE CRAWFORDSVILLE CRINOIDS.

PROF. D. A. BASSETT.

About thirty-five years ago, the students of Wabash College in their rambles along the bluffs of Sugar Creek, not far from the town of Crawfordsville, were greatly delighted with beautiful little cavities which they discovered in pieces of rock picked up or pulled from the loose shale of the bluff. These cavities resembled moulds of beautiful flowers. There was the impression of a slender stalk, a calyx singularly marked with rows of little dimples, and a corolla of long slender petals with delicate pinnate fringes. These were impressions left in the rocks by fossil crinoids whose decayed remains had been washed away.

As I am informed, the first crinoid found in this locality was picked up by Rev. H. C. Hovey, at the time a student in Wabash College. This specimen, however, differed so much in form and appearance from the beautiful impressions alluded to, that it suggested reptiles rather than lilies, and hence was labelled, "a petrified toad" by this young scientist, who has since won for himself much honors among the caves.

The deposit from which the crinoids were taken, is situated in the bluff on

the right bank of Sugar Creek, one mile north of the city of Crawfordsville, Montgomery County, Indiana. It extends up and down the creek a distance of about thirty rods, cropping out towards the northeast, and pitching under the creek towards the southwest. How far it extends into the bluff is not known, but probably not very far. This small space of four or five acres seems to be the only spot in Montgomery County where these fossils are found, and the only one in the world where they are found in such abundance, and in such favorable conditions for excavating and preparing them for the cabinet. For some reason this seems to have been a favorite locality with these remarkable animals of the carboniferous seas.

Geologically, the beds belong to the Keokuk Group of the sub-carboniferous period, and are composed of argillaceous shale, loose and much broken at the top, but more compact and solidified below. The rock is stratified, and indicates aqueous deposit in quiet waters. In color the strata resemble French gray, or light lead color tinged with blue. The upper strata for several feet have been bleached to a light brown by infiltrations of the surface-water. The strata vary in thickness from one to three feet, and the hardest of them, owing to their shaly character, may be quite easily split into slabs of various thicknesses.

Remains of crinoids and other fossils, decayed and worthless, are found quite abundant at the very summit of the shale, and continue to the depth of fifteen feet. The next twenty feet are almost entirely destitute of fossils of any kind, and the cessation of life above and the beginning of life below are very abrupt. The first crinoids, sufficiently well preserved for cabinet collections, are found at a depth of thirty-five feet from the top of the bluff, and most of this distance the rock must be blasted. Below this point, crinoids have been found at different intervals as far as excavations have been made. They do not occur in all the strata, neither are they uniformly scattered through those in which they do occur. For the most part they seem to have lived in schools, or clusters, sometimes crowded so closely together as to be lying one upon another five or six deep. In a slab measuring three feet by two and a half, taken from one of these clusters, and the matrix so removed as to expose the fossils in their natural position, there were eighty crinoids besides several other fossils of different genera and species. The crinoids with their curious heads, and their long stems crossing and recrossing each other, lay stretched out one above another in every direction. Among the crinoids in these clusters are frequently found mollusks, trilobites, conularia, archimedes, pentremites, ongchasters and protasters, and some others, strangers to the writer.

These clusters usually extend but a few feet, and generally terminate abruptly, and where another such shall be found, is a matter of chance, involving much time and hard labor. An occasional crinoid, usually of larger size and more perfect than usual, may be met with in the intervals between these clusters, but in the intervening spaces between the bearing strata, which vary from one to several feet, we may look in vain for any crinoids fit for the cabinet—nothing but fragments of heads and stems, evidently the work of mollusks.

The crinoids from the Crawfordsville beds are remarkably well preserved. They are evidently lying just where they lived, died and were buried in the ocean ooze thousands of years ago. During all these ages, they have remained undisturbed, so that the finest markings and most delicate tentacles and pinnule are perfectly preserved. And such is the nature of the matrix in which they are imbedded, that with sufficient care, patience and skill, they may be so removed as to restore the animal with all the parts entire. Such specimens are not only very beautiful, but they also afford the very best opportunity for studying the structure, nature and habits of these animals.

It must not be inferred from what has been said, however, that all the specimens obtained in these beds are perfect. So far from this being the case, probably not more than twenty per cent of the heads found are perfect, while an *entire* crinoid, head, stem and root, of the larger species, is so seldom met with, that the author in all his excavations, extending through several years, has never found but one. That may be seen among the many other rare specimens, in the museum of Wabash College.

For more than two hundred years crinoids have occupied the attention of scientists. During that time they have certainly received their full share of attention. Agassiz tells us that up to his time not less than three hundred and eighty authors had published their investigations upon the crinoids, and that the books printed about these animals would furnish a library in themselves. And to this we may add, that there are many questions connected with the subject still unsettled.

The perplexity concerning the true nature of the crinoid commenced in the sixteenth century. Small, round, flat stones with holes through them, and impressions of little stars upon their sides, excited great curiosity. "What are they?" was the question. The common people called them pulley-stones, and St. Cuthbert's beads, and wore them for ornaments and used them for rosaries. Scientists, puzzled and perplexed, called them *trochites*, from the Latin trochus, a wheel. In process of time, beautiful impressions were found in the rocks, much the same no doubt, as those found by the students of Wabash College along the banks of Sugar Creek. These were supposed to represent fossil plants, and what name more appropriate than *Crinoid*, from the Greek *Krinon*, a lily. In process of time, this idea of the nature of the crinoid was still farther confirmed by the discovery of a single specimen from Porto Rico, "described," as Professor Louis Agassiz tell us, "by the naturalist Gueltard, which was so similar to the fossil lilies of the rocks, that he called it a marine palm."

The French naturalist, Cuvier, was the first to discover the true nature of the crinoid. Careful study of the Trochites, the lilies of the rocks and the marine palm, revealed to him the relation existing between them and the fact that the crinoid was not a plant, but a marine *animal* of the sub-kingdom radiata, and class Echinodermata.

So striking is the resemblance between some species of the crinoid and some kinds of plants, that, while the correctness of Cuvier's deduction is not ques-

tioned, the idea has for a long time prevailed that the crinoid is really two-fold in its nature, animal and vegetable combined, thus constituting a connecting link between the two kingdoms. According to this idea, the crinoid was a marine animal-plant, whose house was in the bottom of the sea, where, with its roots anchored in the mud, or ooze, to some rock, stone or stick, it grew, budded and sent forth branches which developed into young crinoids. Such is the idea advanced by a writer in *Harper's Monthly* for February, 1879. "The true animal plants however," he remarks, "are without doubt crinoids or stone lilies. With them the resemblance is almost perfect, to the minutest particular. They resemble a flower borne upon a stem terminating in an organ called a calyx, which is, properly speaking, the body of the animal. Branches issue from the main stem, which at its base bears a sort of expanding root planted amid the rocks, and capable of growing by itself and nourishing the stem." The same idea has been more elaborately and poetically stated elsewhere.

According to this, the natural position of the crinoid is vertical, its roots buried in the mud and firmly anchored to some solid support. "In this way they lived and grew and flourished like beds of roses or other flowering shrubs. The extremities of the branching stalks budding, bloomed into young crinoids which after a time, having grown somewhat strong, cut loose from the parent stock, and floating off, roamed at pleasure through oceans depths until satisfied with this roving mode of life, and being more perfectly developed, it too settled down as its ancestors had done, and fastened its roots among the rocks, or in the mud, and there grew, and expanded its branches and put forth buds, and bore its crop, and sent out its progeny to assist in peopling the depths of old ocean. Those long stalks enabled the head to sway and move about within a certain distance, and with its long slender arms with their feathered pinulæ to seize the unwary minnow or star-fish or mollusk which happened to stray within its reach."

This is the poetry of science. Very beautiful, and attractive. Such was the crinoid the writer expected to find as he commenced excavations in these Crawfordsville beds eighteen years ago. But those dreams have never been realized. After years of delving and most careful search after what we fully believed to be a reality, we are reluctantly led to the conclusion that whatever may be found in other deposits, no such fossil exists in this. As we have read the description of the crinoid as written by nature herself in these rocks, it differs materially from the fancy sketch above.

We find no evidence of a dual nature in the crinoid—animal and plant combined—a connecting link between the animal and vegetable kingdoms. This idea has no doubt originated in the striking external resemblance of some species of crinoids to certain plants, and especially to the lily. But this resemblance, even in the most striking cases, is only external, while the *internal* structure in every instance is entirely different.

Furthermore this resemblance, instead of being general as many suppose, is really of rare occurrence. Most species of crinoids in their external appearance

would never suggest the idea of a plant, and least of all a lily. The young scientist named his first specimen "a petrified toad," and the resemblance is very striking. He might have named another "a petrified chicken's claw" and he would have had the scientific name in English, and a likeness even more striking than in the first case. Who would ever think of calling the warty *goniasteroido-crinus* with its long flexible stem coiled and knotted like a snake or some great worm, and tapering to a perfect point—who would think of calling this thing a connecting link between the animal and vegetable kingdoms? And how such things as these are to anchor themselves to some stick or stone and maintain an upright position is more than we can imagine. Very many species of crinoids have nothing to resemble a root at the extremity of the stem. And where this resemblance does exist, there is not the least evidence that they served any of the purposes of a regular root.

Of those spreading branches, budding and putting forth young crinoids "to people old ocean," we find not the last evidence. The theory is doubtless a deduction from analogy. The testimony of the rocks upon this point is very meager, but from the best evidence we can find we incline to the belief that these Paleozoic crinoids were oviparous.

Since the days of Cuvier, much time and attention have been given to the study of these animals, especially their structure and classification. In form they present almost an endless variety. Upon this point we quote the beautiful language of Professor Louis Agassiz: "After thirty years' study of these fossil crinoids, I am every day astonished by some new evidence of the ingenuity, the invention, the skill, if I may so speak, shown in varying this single pattern of animal life. * * * They seem like the productions of one who handles his work with an infinite ease and delight, taking pleasure in presenting the same thought under a thousand different aspects. Some new cut of the plates, some slight change in their relative positions is continually varying their outline, from a close cup to an open crown, from the long pear-shaped oval of the calyx in some, to its circular, or square, or pentagonal form in others. An angle that is simple in one projects by a fold of the surface and becomes a fluted column in another; a plate that was smooth but now has here a symmetrical figure upon it drawn in beaded lines; * * * . It would require an endless number of illustrations to give even a faint idea of the variety of these fossil crinoids."

The limits of this article will admit only of a general description of the structure of these animals. The head, which in some species resembles a flower, is really the body of the animal, and consists of a cavity or calyx composed of a number of calcareous plates, joined together in the living subject by membranous attachments. Within this cavity were enclosed all the vital organs. In some instances the vault of this cavity is prolonged into a slender tube varying in length in different species. The cavity of most crinoids is fringed with arms, ple, others branching, the number varying with the species. These lso composed of calcareous plates arranged in single, double or quad-

ruple rows. Some of these much resemble the scales of a chicken's foot, others the braids of a whip lash, others still the rows of kernels upon an ear of corn. These arms contain ambulacral processes which connect with the organs of nutrition within the cavity or calyx. The inner edges of these arms are fringed with pinulæ or filaments resembling the margins of a feather or quill, or with tentacles. Through these delicate organs it is now supposed that the animal absorbed a glutinous substance found at the bottom of the sea, which, passing through the hollow spaces within the arms into the organs of nutrition within the calyx, nourished the animal. This of course is at variance with the idea advanced in both extracts above, and illustrated by a cut in Murchison's Silurian and in some early geologies, which represents a crinoid with its long, slender proboscis thrust into the shell of a mollusk upon which it was supposed to be feeding. But without doubt, this picture, thus explained, reverses the order of nature. The mollusk was feeding upon the crinoid. Various facts confirm us in this opinion.

In the first place it is now quite well established that the proboscis, once regarded as a passage for food, is really an anal tube, and that there is in the Paleozoic crinoids no oral opening through the wall of the calyx except the passages connected with the ambulacral processes of the arms. Furthermore, we have in our possession a number of specimens with mollusks, especially *Platyceras infundibulum* (M. & W.) firmly attached to the crinoids, and in every case the aperture of the mollusk covers the anal opening. In all these cases therefore, the crinoid could not have been feeding upon the mollusk, unless this opening is both anal and oral, as some suppose. If this be the case, and the crinoid is really devouring the mollusk, then we should expect to find the crinoid in a healthy condition in every case, and the mollusk the reverse. Now the fact is that of a large number of specimens of this kind, in every instance the mollusk is in a perfect and healthy condition, while the crinoids, in nearly every instance, are more or less imperfect and decayed. The apparent exceptions are cases in which it is evident that the mollusk became attached to the crinoid only a short time before both perished. It is exceedingly interesting to note the different stages of decay in the crinoid as illustrated in the specimens alluded to. First there is a slight depression of the calyx opposite the anal; then it is cupped more and more. Finally the calyx is completely collapsed, and so the process continues until nothing is left but the plates and rings, which lie scattered about the aperture of the mollusk, which has continued to become more stout and robust throughout the entire process. I have repeatedly found a *Platyceras equilatera* attached to the anal tube of *Actinocrinus indianencis*, and *A. ramulosus, and inclosed within the arms*. At first I congratulated myself upon the discovery of a case in which the crinoid was actually feeding upon the mollusk. Examining the specimen more carefully, I discovered that the proboscis was entirely gone, and the plates were lying about the aperture of the mollusk, and that the aperture was fastened upon the vault and directly over the opening into the cavity. A great number of such specimens as these have convinced the writer that vast

numbers of these animals were destroyed in this way, and that the crinoids did not subsist upon "minnows, or star-fishes, or mollusks that happened to come in their way." Indeed, we must confess that after years of very careful observation we have never yet found a specimen which furnished *satisfactory* evidence as to what the crinoid subsisted upon.

To the head of the crinoid was attached an appendage, which, for want of a better name, we call a stem. This is composed of a series of flat calcareous rings or plates, perforated at the center. The reader will recognize in these plates the Pulley-stones, and St. Cuthbert's Beads already alluded to. The broad surfaces of these rings, in the larger species especially, are striated from the central perforation to the circumference. As the surface of the plates enlarges towards the circumference the striæ bifurcate to keep the intervening spaces all equal. These plates are laid one upon another, the surfaces being so arranged that the striations of the one fit exactly into the little grooves of the other, the sutures around the margins having the appearance of saw-teeth fitted together. By this means the possibility of any rotary movement of the plates upon each other seems to have been effectually prevented. This, however, did not prevent considerable flexibility in the stem, as in the case of the *Goniasteroidocrinus* already alluded to.

So great is the diversity in the exteral margins of these rings, that it is easy to distinguish many species by the appearance of the stems. We feel satisfied that, before a complete and satisfactory classification of these animals can be made, these stems will need to be more thoroughly studied. Endless variety would seem to be the design of nature in the construction of these stems as in the other parts of these animals. And equally interesting is the study of the different construction and markings of this singular appendage.

The growth of the stem seems to have been by successive additions of new plates at the junction with the base of the head. In most species these at first are quite thin, but they increase in thickness as the formation of new plates removed the older ones farther and farther from the point of origin. By this double process, no doubt, the stems were lengthened. These plates were doubtless held together by muscular attachments, and the cavity within filled with animal substance.

Everything seems to indicate that these stems, and the arms as well, were exceedingly fragile, and on this account, it is very difficult to obtain an entire crinoid, or even a head with a long piece of stem attached. No doubt many suppose this is owing to the difficulty of removing the specimens from the quarry without breaking, but such is not the case. The fact is, the crinoids were broken before they were fossilized, even while yet alive. In the large slab already alluded to, containing eighty crinoids, not more than half a dozen were entire, and these were mostly young specimens, or small species. The stems were nearly all broken, having been slipped apart at the joints, leaving stumps of various lengths attached to heads. In removing the matrix from specimens in these large slabs, I have repeatedly found the stems disjointed by too short a

fold in the sinuosities, or by some short turn in the direction of the animal's course in forcing its way through the mud, the parts being left in such relation to each other, as to indicate, not only their connection, but also the method by which the separation had been made. In this way the stem is not only broken once, but in some cases, several times. These facts, with others, incline the writer to the belief that the natural position of the crinoid was horizontal rather than vertical, living in the mud at the bottom of the sea.

The long slender arms, with their fringes of pinnulæ or tentacles, were also easily disjointed, especially at the point of connection with the calyx. Very few specimens retain them all entire. Frequently the arms are all gone, leaving nothing but the calyx. We have frequently found these long slender arms turned back upon the stem and disjointed, three or four of them sometimes, lying near together, some near the head, others a few inches back along the stem, as though the animal had left them behind in forcing its way through the mud. In removing the matrix from specimens, and especially in the large slabs, these detached arms are frequently met with. It will be seen from these facts, that the value of cabinet specimens must increase very rapidly in proportion to the perfection of the head, and the length of the stem.

It is an interesting fact that these Crawfordsville beds very clearly indicate a deterioration in the crinoids in ascending from the lower to the higher strata. In the outcrop near the level of the creek, are found remains of crinoids perfectly enormous compared with the same species higher up in the bluff. If the heads connected with these fragments of stems, bore the same relation to them that the heads above do to their stems, they must have been giants from eighteen inches to two feet in length. But no heads belonging to these stems have ever been found. As far as excavations have been made, the largest species and the largest specimens of species which extend to the top of the shale, are found in the lowest strata. Long ages must have elapsed during the formation of these rocks, and the period of life recorded in them.

Near the commencement of the Carboniferous period here represented, the crinoid seems to have reached the zenith of its glory in size and in numbers, and then began to wane, leaving in the same deposit the record of its glory and of its decline.

THE GEOLOGICAL SURVEY OF KANSAS.

A geological survey, carefully made, of any extended area, reveals the character of the rock formations for several hundred feet of thickness, and therefore makes known where *may* or *may not* be found the useful minerals—coal, salt, building-stone, iron, lead, etc.

Such a survey also makes known the *dip* or slope of the strata, and therefore gives indications of probable water supply in various localities.

Much geological knowledge of Kansas has been obtained, but it is in the

hands of private persons who have in their devotion to science made many explorations, but this knowledge is available by the public generally to a very limited extent. Within the last two years, geologists have found minerals in our western counties which further examination will doubtless show to be of considerable value, and which are even now being utilized.

Nearly all civilized countries have caused surveys to be made which, conducted simply as for the definite advancement of science, have yet revealed material resources which have largely added to the outlets for the useful employment of capital and labor.

Many of our sister States have caused geological surveys to be made, extending over a long series of years, which have made known mineral resources the use of which has greatly increased the wealth of the State.

In Michigan, there are now millions of dollars of taxable value in salt works, the existence of which is due entirely to the geological survey.

One county in Ohio (Tuscarawas) has a large industry in mining coal, the existence of which was made known by the geological survey. The State of Ohio as a whole has been immensely benefited by the survey, on which it has expended large sums.

The great State of New York has employed eminent geologists for a long time with experts in other departments of science, at a total cost of over half a million dollars, and the evidence of the most direct kind shows that the expenditure has resulted in the profitable investment of capital to a great amount; and unprofitable investments in prospecting for minerals, which were formerly common in that State, have ceased since the definite results of the survey have been made known.

In every State that has tried it, benefits have been received from this work in proportion to the time and expense that have been spent on it.

In our own State, the lack of definite knowledge as to the boundaries of our coal fields has led to the expenditure of capital in many useless undertakings. For example, in Morris County a shaft to the depth of three hundred feet was sunk; in Sedgwick County a depth of eleven hundred feet was reached, and in Marion a boring of seven hundred feet was made—all at great cost and without any returns.

Ignorance of the principles and facts that govern the supply of water in wells is in many places leading to similar wasteful experiments. A geological survey would stop this waste, and point out directions where labor would meet with reward and capital increase by investment.

The cost of a survey is so small, compared with the advantages to be reaped, that there should be no longer delay. A tax of one-twentieth of a mill would produce about as much revenue as it would require to put the survey in good working condition, though a larger sum would hasten the final accomplishment. This continued for a series of years would produce results in scientific and economic progress, of which all citizens would be justly proud.

THE LAST SUBMERSION AND EMERGENCE OF SOUTH-EASTERN KANSAS FROM THE CARBONIFEROUS SEAS, OR THOSE EFFECTING THE CARBONIFEROUS FORMATION IN KANSAS.

E. P. WEST, UNIVERSITY OF KANSAS.

[*Continued.*]

Since my paper, bearing upon this subject, was read before the Kansas Academy of Science, at its recent session in Lawrence, I have had an opportunity to extend the boundary of my observations to a limited extent; embracing a very small field of strata newer than the Permian formation.

These extended investigations tend to confirm the opinion I expressed in the paper referred to, that the wide-spread erosion in South-eastern Kansas may have occurred at a comparatively recent time. These newer strata were involved in it as well as the coal measures and Permian formation, and I have no doubt the cretaceous (if the newer strata referred to do not belong to it), tertiary, and early post-tertiary strata also. These and other facts which have been ascertained, pertinent to the subject, would indicate the later Post-Tertiary or Champlain epoch as the era of these occurrences.

Near Wellington, Kansas, and in a large area of country around it, extending westward to Harper and Attica, along the Southern Kansas Railway, ancient, modified drift is encountered. At Wellington, and many other places in the country adjacent, these beds are worked for the sand they contain. Fragments of the local rocks, which have been torn down from their beds, are profusely intermingled in them. The process of obtaining the sand, when mined, is by running it through a sieve to separate the drift gravel and fragments of local rocks from it. The pits show the gravel beds to be stratified, and evidently deposited by water, and being too extended for river work, they must be assigned to the same agency which wrought the distinction in other portions of southeastern Kansas, *i. e.*, to water aggregated in shallow seas. Mixed in with the sand, gravel, and fragments of local rocks, the bones of extinct post-tertiary animals are frequently found, namely, the mastodon, elephant, bison, and others whose species have not been determined.

In the Loess deposits, bordering the Missouri River, though not so frequently encountered, the bones of the same animals are found, together with the shells of Helix, Planorbis, Succinea, and other land and fresh-water shells identical with living species in the same locality. These remains are buried all through the Loess, from near the surface to a depth of from one hundred to two hundred feet.

The bones of a very large elephant were found in the alluvial deposits at

Ottawa, Kansas, and other similar bones in an equivalent deposit near Papinsville, Missouri. At this latter place the tooth of an extinct species of the horse was found in a bed of water-worn pebbles, under alluvial deposits, thirty-two feet below the surface.

Since my paper was read one of the students, Mr. Joseph Thoburn, has presented to the University some water-worn pebbles from Marion County, Kansas, which contain fossil shells identical with the shells of the undisturbed local rocks of that county and, a few days since, there was received, at the University, a fine specimen of petrified wood, from Russell County, sent by the Rev. J. D. Parker, U. S. A. This specimen is similar to the silicified wood referred to in my paper, and which is so generally distributed over southeastern Kansas. But whether this specimen was found upon the surface or in the alluvial deposits of that county is not stated.

Near Scipio, six miles north of Garnett, there is a small patch of rocks standing vertically to the plane of stratification, having evidently been tumbled down from a higher level. I am told they are sandstone, but I have only seen them from the car windows while passing on the railway. The other rocks, in the vicinity, are all limestone, and their stratification is undisturbed. Between Scipio and Garnett, and south and west of the latter place, sparsely scattered over the surface of the country there are found small masses of flint, from one to six or eight inches in diameter, very similar to that seen in the Flint Hills, and it is probable that a spur or local bed of the Permian strata, of no great thickness, was destroyed in this scope of country.

These facts in connection with those in my former paper would indicate pretty conclusively, that the denudation of southeastern Kansas and the deposition of the Loess along the Missouri River occurred at the same time; that the submergence involved nearly all, if not all, of Kansas as well as parts of Iowa, Nebraska, Missouri, Illinois, Arkansas, Louisiana, Indian Territory, and Texas, and, that a part of the Permian formation outlying in spurs or local beds may have been destroyed.

The submersion of the land was most probably as gradual as its emergence undoubtedly was, for the Loess deposits along the Missouri River could only have been made in still waters which were very gradually receding; and every successive inch of the river, from Omaha, Nebraska, to the present outlet of the Mississippi River at the Gulf of Mexico, at one time during the subsidence of the waters must have been the mouth of the stream.

The encroachment of the water began at the shore line of the Gulf of Mexico, wherever that may have been in the later Post-Tertiary time, and extended, more or less gradually, until the country within the limits before named, at least, was under water. During this time, the rivers emptying into the seas would deposit sediment at their mouths, and the mouth of the stream would recede, upward, as the waters of the seas advanced. But it was during the retiring of the water that the Loess deposit was given its final and distinctive character as such. The recession of the water was from up the streams downward, and the

mouth of the rivers would advance and leave their deposits of sediment, as the water of the seas retired.

But none of the rivers which emptied into those seas have a well-defined Loess deposit except the Missouri. The Kansas, the Arkansas, and their tributaries seem to have had their debouch into interior lakes during the recession of the water and their sedimentary deposits, which were very limited in amount, were made in them. The Missouri was the only river, perhaps, which had an uninterrupted gradual fall during the elevation of these lands for the last time.

Most of the Post-Tertiary animals, which before had drawn abundant sustenance from the country, were destroyed by unfavorable conditions and became extinct during this last invasion of their province.

Another important question remains to be answered, *i. e.*, whether man witnessed these occurrences? We have reason to believe that he did, and survived the unfavorable surroundings which destroyed most of his humbler co-habitants. His remains have been found, both in Europe and in this country, associated with older formations. His bones and implements have been found in the alluvial deposits of this era under conditions which leave but little doubt that they were buried in, by natural agencies, during their pendency. His monuments stand out, conspicuously, in unbroken lines, for hundreds of miles from the summits of the graceful Loess hills which had their birth in this epoch. He has sculptured the greatest of the extinct mammals, and could only have drawn the conception from the living animal. The conditions were not very dissimilar from those of to day; and we may feel assured that he played a leading part at this stage of the world's progress, as he has since done in a more conspicuous manner.

Before closing this paper it is but just that I acknowledge, on behalf of the University of Kansas, the courtesy of the officers of the Southern Kansas Railway extended to it, and thank them for the interest they have always manifested in the advancement of science and the development of the material resources of Kansas, especially those great interests along the line of their road. Personally, I must acknowledge the invariable kindness I everywhere received from all the officers and employees of the road during my work along its line; and the pick and shovel, associated with these courtesies, will ever be among my pleasant remembrances.

KANSAS SCIENTIFIC SURVEY.

PROF. JOHN D. PARKER, U. S. A.

The Kansas Academy of Science, at the late annual meeting at Lawrence, took steps to inaugurate a thorough scientific survey of the State of Kansas. In the early history of the State two preliminary reports were made by Professors Mudge and Swallow, and the members of the Academy have made valuable

contributions to our knowledge of the science of the State in several departments. Prof. O. St. John, the accomplished paleontologist, has run a stratigraphical line along the Kansas river from Wyandotte to Manhattan, has carefully determined the formations, and has drawn a chart representing the strata along this base line. He has also, during the past year, located some valuable coal fields in Southern Kansas beyond what was supposed to be the boundary of the coal formations. Prof. Frank H. Snow of the State University has made important contributions to our knowledge of the birds and insects of the State, and of the fish in the Kansas River. Prof. E. A. Popenoe of the Agricultural College, has made valuable additions to our knowledge of the insects. Professors Carruth and Snow, with the assistance of others, have worked faithfully on the catalogue of the plants of the State. Profs. Snow and Lovewell, Major Hawn and others have taken meteorological observations for years, and have done much to determine the climate of Kansas. Mr. Robert Hay has performed some excellent geological work in Norton county, under the auspices of the Academy, and has published a geological map of the county. Professor F. W. Cragin of Washburn College has published partial lists of Kansas mosses, lichens, algæ and fungi, and has made a good beginning in collecting and identifying the lower plants of the State. The chemists have also been at work, and Professors Failyer, Patrick, Bailey, and others have made some valuable analyses. All of this labor of the Academy, covering about two decades of years, has been accomplished by volunteer workers, without costing the State of Kansas a single dollar.

The time has now fully arrived for the Kansas Legislature to take up the scientific survey of the State, to utilize the results already attained, and to carry on the work so well begun to its completion. Kansas is unusually rich in mineral resources which need to be developed by a thorough and complete geological survey. Very little is known at present of the immense coal fields of the State. The lead interests are still in their infancy. Probably there are zinc deposits undetermined. The State has unlimited beds of limestone and freestone, constituting the finest building material in the West, much of which is undeveloped. The Burlington Gravel Beds furnish some of the best gravel for our street pavements, and would, if thoroughly explored, furnish an abundance of the best ballasting for railroads. A physical survey would determine the water power of the State, enabling capitalists to plant factories wherever they can be established. Little is known of the saline deposits of the State. The vast gypsum beds of Kansas need development. A thorough and complete survey would develop these immense resources, form a basis for material industries of every description and add largely to the wealth of the State.

Geological surveys have been prosecuted in the leading States of the Union with the most valuable results. In Michigan there are now millions of dollars of taxable property in salt works, the existence of which is due entirely to the geological survey. The survey developed two rich salt deposits, and the annual export of salt has now reached about a million dollars. The Ohio geological survey developed a fine industry in mining coal in Tuscarawas county. New

York has spent over half a million dollars on her scientific survey, and her rocks have become classic ground. The New York scientific nomenclature is known in all countries, and is the nomenclature of our best geological text books. Her survey has resulted in the profitable investment of a large amount of capital, and since the definite results of the survey have been made known, the unprofitable investment in prospecting for minerals, formerly so common, has ceased. Several other States have prosecuted geological surveys which have fostered many industries and added much to their material wealth.

But the scientific survey of any country has, we believe, a higher and a broader plane than even the development of its mineral resources. A free and an intelligent people, like those of Kansas, stand related to nature, at many points where science touches the inner life. Nature in her material aspects, contributes to our physical wants, and supplies from her abundant resources the materials with which our homes are constructed, furnished, and beautified. But in a deeper sense nature speaks a language which fills the thoughtful mind with higher and better truths. When nature unfolds her deeper meaning to the percipient mind science begins to fertilize every department of life. The people of Kansas need ample collections in all departments of nature to illustrate scientific studies. The State has already suffered irreparable loss in the transportation from her Western borders of the finest and rarest specimens, to enrich the cabinets of Eastern colleges and universities. Prof. Marsh of Yale College has paid $1,000 a year to cover the transportation of vertebrate fossils, collected in Western Kansas. Such materials are the richest endowments of educational institutions, and are indispensable in educational processes when conducted on the best plan. Kansas can ill afford to let Eastern institutions rob her colleges, on account of her lethargy, of rare material of learning which, once gone, can never be replaced.

During our civil strife, Kansas won golden opinions over the civilized world for the advanced position she took and held in the maintenance of the ideas of freedom. She has a double land grant for the establishment and maintenance of public schools, and her State University has already exhibited a wonderfully vigorous growth. Her Agricultural College, in spite of many discouragements in past years, is beginning to yield excellent results. Intelligent people all over the State are very anxious to have the scientific survey begin at the earliest practical moment, for Kansas cannot afford to lag behind her sister States in this fundamental work which lies at the base of the highest physical development and the best intellectual culture.

The Legislature of Kansas can not do any act which will contribute more to the welfare of all the people of the State and be more acceptable to all intelligent citizens, than to inaugurate the geological survey of the State during the coming session.—*Kansas City Journal.*

THE AGE OF THE WORLD.

REV. L. J. TEMPLIN.

Scarce a generation has passed away since it was the almost universal belief among the common people that the earth, in both its material and form, was only about 6,000 years old. When geology began to teach that the age of the world was to be reckoned by not only thousands and tens of thousands, but by millions of years, it was arraigned as being in opposition to the word of God, being infidel if not atheistic in its tendencies. But now, few if any persons, who have any just claims to be considered intelligent, question the great antiquity of the earth. But only those who have given special attention to the subject are aware of the vast amount of evidence in favor of this view that is presented by the present condition of the rocks composing the solid crust of the earth.

To give even an abstract of all the proofs that exist in favor of this doctrine would require a large volume; much less can it be compressed within the narrow limits of a magazine article. A cursory view of a few representative facts and general principles, is all that can be attempted in the present discussion.

There was doubtless a period in the earth's history when its whole mass was in a state of igneous fusion. When it had become sufficiently cooled to permit the existence of water on its surface, currents would be formed, and erosion would begin. The eroded material would be deposited in still water and form sedimentary rocks. These would be laid down in horizontal, or nearly horizontal, strata. The cooling of the earth would cause contraction, and this would produce subsidence in places and upheavals in others. By these means the strata, already laid down, would be broken, contorted, and tilted at various angles, leaving the edges exposed. As erosion would go on, new strata would be deposited on the upturned edges of the older strata, but unconformable with them. These coördinate processes would go on as long as the vertical oscillations in the crust of the earth should occur. And they have been in operation from those early times, when all the water on the earth was probably kept at a boiling temperature, till the present, and we find them still in operation, and still producing the same results. In studying the sedimentary rocks, it should be always kept before the mind, that they have been formed by the double process spoken of above; and that these have exactly balanced each other; the denudation being exactly commensurate with the deposition. The amount of this sedimentary matter, in the aggregate, is enormous.

The various formations vary greatly, being thicker in places, thinner in others, and entirely wanting in still others; but taken altogether, they constitute a thickness of about 72,000 feet, or thirteen and a half miles. In considering these rocks in relation to time, the mind should divest itself of all idea of reduction to any statement in years. But there are numerous facts connected with

their formation that indicate an enormous lapse of time. The enormous depth and vast extent of some of these formations, with certain attendant facts and conditions, impress the mind almost with the force of a demonstration, that the lapse of time during their formation must have been inconceivably great. Let us begin with the Laurentian, the oldest fossil-bearing rock known to exist. These are found to exist over a wide extent of country in both America and Europe. They attain their greatest known development in Canada, where they exist to the thickness of 40,000 feet. Supposing that they were formed by the gradual detrition of older rocks, and the deposition of the debris at the bottom of the ocean, the time required for the accumulation of such vast quantities of rock material must have been very great. This fact seems further evident from the presence in these rocks of certain substances that were accumulated in them during their formation. Interstratified with the rocks, and sometimes existing in pure beds, is found large quantities of graphite. This is doubtless the result of the perfect carbonization of vegetable matter.

The growth of this vegetation would require long lapse of time, after which it would probably pass slowly through the various grades of lignite, brown coal, and anthracite, before reaching the stage of graphite. Another fact that seems to demand the same interpretation in its relation to time, is the vast deposits of iron ore during the Laurentian period. It is in the rocks of this period that we find the rich iron beds of Missouri, New Jersey, Lake Superior, and Sweden. This ore is supposed to have accumulated by the leaching of the oxides and carbonates of iron from the rocks, and its precipitation under the influence of decaying vegetation.

Now if all the vast beds named above have been deposited by this process, it must have consumed almost inconceivable time. The great Iron Mountain, of Missouri, itself is estimated to contain not less than 600,000,000 tons of iron above the level of the surrounding country. Extensive beds of limestone are also found here; and as these are supposed to be composed of the shells of molluscs and protozoans; the time for them to live and die in quantities sufficient to form such extensive beds of their calcareous remains, could scarcely be reckoned in years. Next above these Eozoic rocks are the Silurian, aggregating a thickness of over 25,000 feet, and crowded with fossils, both animal and vegetable. More than 10,000 different species of fossil animals are already known to belong to this system. These are not, as we would naturally expect from the age of the rocks, of simple and primitive forms; but they are of widely differentiated and highly specialized forms. Coming in as they do, suddenly, in such great variety, and on such a high plane of organic life, how to account for their origin on the hypothesis of evolution has been a very difficult problem. In order to surmount the difficulty, believers in this doctrine generally take refuge in the assumption that between the close of the Eozoic age, and the beginning of the Silurian age, as represented in the rock of the two systems, there must have been an enormous lapse of time, exceeding in extent all the time required for the formation of the rocks composing both these systems.

It was during this long interval that all these organic forms were evolved by natural selection. When asked why such must have been the case it is answered that we must admit this explanation or we have no explanation; and because it cannot be disproved, therefore it must be true. And this is called science. There is abundant proof of the enormous lapse of time without resorting to this manner of assuming that our ignorance is knowledge. Such a lapse of time may have passed in this interval, but that such was the case is without proof except as the evolution hypothesis is assumed as proof; but this itself is sadly in need of proof. We pass over the next—Devonian—age with the single remark that the rocks of this system, containing the fossil forms of numerous species of organic forms, especially fishes, give proof that long ages must have elapsed during their deposition.

We next come to the carboniferous age—age of acrogens or coal age. Here we find the most indisputable evidence of enormous stretches of time. The footprints of time are so indelibly impressed on the rocks of this age, that in some places some approximation to a calculation may be made. The thickness of the rocks of this system vary from 9,000 feet to 15,000 feet. The coal measures proper vary between 4,500 and 13,000 feet. We here have the most striking proofs of the frequent oscillation of the earth's crust. The seams of coal, which compose but a small portion of the thickness of these rocks, are interstratified with the various strata of sandstones, shale, and limestone composing this formation.

As coal is the product of vegetation, which must have grown at the surface, it is evident that to form the seams of coal found at various depths would require that each of these various horizons should have been at the surface at the time when the material forming the coal was accumulated. Now, we find in different coal-fields considerable numbers of these seams separated by intervening strata of rock. Thus in Nova Scotia there are 81; in Wales 100; in Belgium 100; in Westphalia 117. These aggregate, in some cases, as much as 150 feet of coal that would be passed through in sinking a shaft from the surface to the lowest coal-seam. It is evident that where these different seams are found, the land has been elevated and depressed at least once for each of the seams found.

There would be a long period when the land surface was above the water; immense forests of vegetation would flourish until a huge layer of it was accumulated, when by some convulsion of the crust of the earth, or by a gentle—perhaps to human eyes it would have been imperceptible—subsidence, it would be depressed below the waves and receive, either from fluviatile or marine sediment, a layer of earthy material, covering the layer of organic matter to a depth of many feet. A reversal of the process by which the land was depressed, again elevates the surface above the waters, and again a layer of vegetation would be produced, to be in turn buried as the former was. And thus these alternate elevations and depressions continued till, as we have seen in some cases, an hundred or more beds of vegetable matter have successively grown

and been buried. The pressure and heat to which this organic matter was subjected after such burial, eliminated the greater portion of the volatile gases and converted it into coal. The time necessary for the accumulation of all the organic matter contained in all these strata, and in the subsidence and elevation, and for the deposition of the sedimentary materials composing the rocky strata interposed between these coal-seams, can not be estimated—even approximately. But we are sure it must have far exceeded all conceptions of duration that we can form from our knowledge of human history. We have no data on which to base any estimate of the rate of the accumulation of sedimentary matter, except the present rate of sedimentary deposition at the mouths of rivers. The present average amount of sediment carried down by the Mississippi amounts to enough to cover one mile square to a depth of 268 feet annually; or about one cubic mile in twenty years. At this rate it is estimated that it would have required about 1,000,000 years to have carried down and deposited the amount of materials that originally composed the rocks of the coal-measures in the coal-fields noticed above.

The time occupied in the growth of the vegetation that formed the various beds of coal may be more nearly approximated. If we assume the amount of vegetation growing on one acre at 2,000 pounds, this would give in 100 years 100 tons. This compressed into coal and spread over an acre of ground would give a thickness of one-eighth of an inch of coal in a century; or 10,000 years would be consumed in producing one foot of coal. This would require, to produce 150 feet, as found in some regions, no less than 1,500,000 years. But probably the growth of coal-plants, with the very high temperature and heavy atmosphere, laden as it was with carbonic acid that prevailed during the coal age, would produce a much larger growth of vegetation than we have estimated, and the time would be accordingly diminished. But making due allowance for this, there is no question but the time required for the growth of all this vegetable matter, the frequent subsidences and elevations, and the accumulation of the sedimentary matter composing the rocks of this formation must have required many hundreds of thousands if not millions of years.

Another remarkable illustration of alternate elevation and depression, or at least of alternate land and water surface is found in the Amethyst Mountain, in Yellowstone Park. This mountain is made up of alternate layers of sand-stone and conglomerates, and the remains of gigantic forest trees. The stumps and trunks of these trees are found imbedded in the rock material of the mountain at various altitudes; the stumps five to six feet in diameter, and the trunks sixty feet long. It would seem that a forest of these gigantic trees would flourish for a time—perhaps for centuries—and then be overwhelmed with a flood, bringing down sand, gravel, and broken stones, completely covering the site of the forest. This would become the soil upon which another forest would spring up and grow, only to be buried up as its predecessor was. And this process of alternate growth and burial has gone on till from one to two score of these gigantic forests have flourished and passed away. Since the last one passed

away the mountain has been elevated 3,000 feet above the river. The time required for all these changes must far exceed all our conceptions of duration.

It is an undoubted fact that the topography of the present surface of the earth has been largely affected by erosion. This process is constantly going on, degrading the eminences, changing the declivities, and gradually wearing away the whole surface of the land. The sum of this erosion, since the last great geological changes, is enormous. The amount of erosion over many portions of England is estimated at 10,000 to 11,000 feet.

In the Appalachian region it is proved that the erosion has amounted in some cases to not less than 20,000 feet in depth. In portions of the Rocky Mountain regions this erosion has been still greater. Professor Powell informs us that in the Uintah region the amount of erosion has exceeded five miles in depth in some places, with an average depth of three and a half miles over 2,000 square miles of country. The time necessary for the removal of so large an amount of material of course would depend on the agencies employed and the energy with which they operated. It would undoubtedly be vast.

Water, aided by frost, is probably the principal agent operating in producing all the erosion that has taken place on the earth. The power of water to "wear away a stone" is witnessed in the wonderful channels they have cut for themselves during the present geological age. The Niagara River has cut a channel about 200 feet deep a distance of seven miles. Mr. Lyell estimates 36,000 years as the time necessary for the accomplishment of the task; but as we know neither the present nor the past rate of progress the river has made, such estimates are perfectly unreliable.

A very noted example of river erosion is exhibited by the Grand Cañon of the Colorado River, which is 300 miles long and from 2,000 to 6,000 feet deep. But we have no data from which to estimate the time required for the river to cut its way through this distance of rock. We do not know the present rate of recession, nor do we know but the river simply followed and enlarged a crevasse that had been formed by some convulsion of nature. As all such data are unreliable, all conclusions drawn from them must be fallacious.

The general erosion of the whole surface of the earth may be estimated by measuring the amount of sediment that is now carried down by the rivers of the globe. As we have previously stated, the amount of materials composing the sedimentary rocks is the amount that has been eroded. This, it is estimated, would be equivalent to 2,000 feet in depth over the whole surface of the earth; and if taken from the present land surface, it would equal an average of not less than 6,000 feet over the whole land surface. The average erosion of the general surface of the earth as estimated from river sediment cannot be less than one foot in 5,000 years. At this rate it would require, to remove an average thickness of 6,000 feet no less than 30,000,000 of years. And this is the estimate some would place on the age of the earth, since the first sedimentary rocks were laid down.

But two facts present themselves for consideration here, that go far to vitiate

all such estimates. One is, the fact that in the earlier ages of the world, the higher temperature that prevailed, and the large per cent of alkaline and acid substances held in solution by the water, would greatly increase its erosive power, thus requiring a far shorter time to produce a definite amount of sediment than is required at the present time. This would require a large reduction of the above estimate. But on the other hand we have the fact that the erosion that is now taking place is principally operating on sedimentary rocks; and doubtless this has been true during a great portion of geologic time. The same material has been laid down and removed again and again, so that an estimate of the time that it would take to deposit the materials of the sedimentary rocks as we know them, gives but a very slight clew to the time since the beginning of their deposition.

We conclude, therefore, that all efforts to deduce from the above data any definite estimate of the age of the earth in years, are futile; and all conclusions drawn from such calculations are fallacious and misleading. In the beginning of this article we spoke of the probable fluid condition of the earth: but if this theory is correct, it is evident that that is not the beginning of the earth's history. The same reasoning that would demand such a condition, would lead us on to a period when this same matter was in a gaseous state; when as incandescent gaseous matter, it was expanded in space. But supposing this to have been the true history of this world, it is evident that no data exist on which to found any estimate of time as applied to this stage of its existence. It is only when it has reached a liquid condition that any basis is furnished for a calculation of time as applied to its history.

Different scholars have attempted a calculation of the age of the earth from the rate of cooling of heated bodies exposed to a cold atmosphere. But the various elements entering into the mathematical analysis of this problem, are so numerous and uncertain, that there is no agreement in the conclusions arrived at. These conclusions vary from 160,000,000 to 600,000,000 of years as the probable time required to bring the earth from a fluid state to its present condition.

From all the foregoing considerations we are led to the conviction that though the earth has existed for an inconceivable length of time, yet from the data at command it is impossible to reduce it, even approximately, to years; that these unmeasured and unmeasurable years are known only to Him who is from everlasting to everlasting, yesterday, to-day, and forever.

CAÑON CITY, COL., January, 1885.

BIOLOGY.

ON THE WASHBURN BIOLOGICAL SURVEY OF KANSAS.

F. W. CRAGIN, SC. B.

It is proposed to conduct, under the auspices of Washburn College, an informal biological survey of Kansas. The work has already been in progress for some months, and will probably require five, and perhaps ten, years for the accomplishment of its objects.

While the more popular portions of our fauna and flora, and particularly our birds, insects, and flowering-plants, have been studied by Profs. Snow, Popenoe and Carruth, Col. Goss, and others, no attempt has hitherto been made at a systematic survey of the entire field of Kansas botany and zoölogy. The work now proposed, while placing our State in a position where, as regards our knowledge of its natural history (geology excepted), it will compare well with its older sisters in the East, will present to science the facies of a typical prairie fauna and flora, will serve to define more clearly the relations of the Eastern, Central, Sonoran and Austroriparian faunal regions, and cannot fail to throw other important light upon the subject of bio-geography and variation.

We have said "geology excepted" because, while there are few States of whose geology, whether considered in its scientific or in its economic aspect, so little is known as of that of Kansas, it is neither part nor possibility of the present undertaking to include a State geological survey. Such a survey is imperatively needed, but is of too great magnitude for private enterprise, and its execution must be left to the State.

The object of the proposed survey is simply to investigate the fauna and flora of a State which, together with Indian Territory, holds the key to a more definite knowledge of the inter-relationship of four great faunal regions. It is believed that this object will commend itself to all intelligent and public-spirited citizens of the State; and the coöperation of such is invited in the collection and donation of specimens of mammals, reptiles, fishes, shells, insects, crustaceans, flowering plants, ferns, mosses, lichens, *Fungi*, *Algæ*, or, in short, of whatever lines of material can locally be collected to best advantage.

The progress of the survey will be recorded in the form of partial reports, or contributions and notes, which will come from specialists to whom the material brought together by the survey will be submitted.

Some of the departments are still unprovided for; but the names of the following eminent specialists, whose services have been secured, are a sufficient ...e for the value of the proposed work: For the fishes, Prof. Chas. H.

Gilbert, of Bloomington, Ind.; land-shells, Mr. Arthur F. Gray, of Danversport, Mass.; fresh-water shells, Prof. R. Ellsworth Call, of Des Moines, Ia.; mosses, Mr. Eugene Rau, of Bethlehem, Pa.; lichens, Mr. H. Wiley, of New Bedford, Mass.; *Algæ*, Mr. Francis Wolle, of Bethlehem, Pa; *Agaricini*, Prof. C. H. Peck, State Botanist of New York; lower *Fungi*, J. B. Ellis, of Newfield, N. J.

A considerable number of volunteer resident collectors and correspondents have already been secured in various parts of the State, and it is hoped that many others may be added. The following points, as yet unprovided for by resident observers, are particularly important stations; and we shall be glad to correspond with any one who can represent these localities for the survey, or direct its attention to such as they think might be able to do so: (1) the Kansas shore of the Missouri River; (2) the Marias des Cygnes Valley, near the eastern State line; valley of (3) Spring and (4) Arkansas River, near the southern State line; (5) Medicine Lodge; (6) extreme southwestern Kansas; (7) Republican Valley, near the west line of the State; (8) Norton County; (9) Blue River Valley, near the northern State Line.

Correspondence is invited from all interested in the subject of natural history in Kansas. Communications and specimens relating to the survey should be addressed to F. W. Cragin, Washburn College, Topeka, Kansas.

Circulars are in course of preparation, giving directions as to the manner of collection, preservation, and transmitting of specimens best calculated to subserve the objects of the survey, and these circulars will be forwarded to any address on application.

Two reports on the progress of the survey—published in the *Bulletin of the Washburn College Laboratory of Natural History*—have already been completed, and the material for the third is largely in hand.

The following sketch will give a fair idea of the general method of the work and of results thus far attained and those still sought:

To the list of Kansas mammals as given by Prof. M. V. B. Knox, some years ago, the survey has been able to add a number of species, among the most interesting of which, as considerably extending the known geographical distribution of the species, are the Mexican Badger, two specimens of which have been found in central Kansas, and the Free-Tailed Bat, found in the northeastern part of the State. Both are southern species and their occurrence in Kansas is a matter of some surprise. It has also added to the State Fauna the Georgian Bat, and is able to record through the favor of Prof. Snow, the Little Shrew, *Blarina parvula*, from western Kansas. It would call attention also to the long lost Black-footed Ferret, or Prairie Dog-Hunter, of western Kansas, whose rediscovery was recorded a few years since by Dr. Coues, and would urge our collectors and hunters to keep vigilant watch for it with a view to ascertaining its distribution and abundance in the State. Does the distribution of this ferret coincide with that of the Prairie-Dog? The survey is also gathering statistics with a view to determining the exact distribution of the Prairie-Dog in Kansas, and its relations to civilization and agriculture. Is the Prairie-Dog favorably or adversely

affected by the advance of civilization upon him? Have the "deserted towns" of this animal become such owing to a desire to shun observation and molestation by man, or were the migrations which they record induced by desire for better forage grounds, or by other causes? Items of information tending to shed light upon the distribution, increase, or extermination, habits, and economic relations of this and other species of the animals of Kansas are greatly desired. For some of our species the historical material must be gathered at once, or it will never be fully known. With birds, as already intimated, the survey is not concerned.

In Reptiles, perhaps the most interesting discovery is that of a second species of Green Snake, the slender Green Snake, *Cyclophis æstivus*, an austroriparian species, collected by Col. N. S. Goss, at Neosho Falls. Kansas is doubtless the northern limit of this bright-hued, active, southern serpent.

Of Fishes the survey has made considerable collections, mainly of smaller forms. Three species new to science have already been described in its reports, and the pretty little Zebra Fish of the Rio Grande River, known until recently by Girard's imperfect description only, has been re-discovered and fully described from material sent from Ellis, Kansas, by Dr. L. Watson. The Zebra-Fish has since proved to be one of the commonest fishes of western Kansas, scores having been taken from a little stream near Garden City by the writer in two days' collecting last August. The Lamprey Eel of Kansas, parasitic on the Buffalo-Fish, etc., proves to be usually the *Chestnut* Lamprey, and the material collected tends to confirm the suspicion expressed by Jordan and Gilbert in their "Synopsis of Fishes of North America" that this and the Silvery Lamprey may be only varieties of one and the same species.

In Insects, the survey has paid attention to only the order of Locusts, including the grass-hoppers, locusts, crickets, and "devil's horses." Collections have been secured in eastern, central and western Kansas and a report on these will appear in *Washburn Bulletin No. 3*.

A few Spiders, Centipedes, and Scorpions have also been collected and in part determined. Of the first, the great "Bird Spider of Texas," sent us from Chautauqua County, by Mr. Charles Hosford, is the most noticeable; and of the second, the long-legged Forceps—centipede, or "Carpet Sweeper" (*Cermatia forceps*), from several localities, is quite a unique.

The collection of fresh-water Crustacea is considerable, but is yet to be studied.

In Mollusks, the survey has collected about fifty species of river- and pond-bivalves, some three-fourths of which have been named, and about thirty species of land and fresh-water snails, mostly determined.

In Worms, little has been done; but a most interesting discovery is that of a still unpublished species of fresh-water Polyzoan, common in our creeks, and the first, apparently, recorded from the plains. It is a branching form, a *Fredericella*, and its graceful resupinate sprays grow upon submerged stones and mussel-shells. The short, stout Hair-Worm, *Gordius robustus*, has been found in Waubaunsee [illegible] one or two other species have been collected but not determined.

No Fresh-water Sponge or Hydroid has yet been found in our Kansas waters.

With our Rotifers and Rizopods nothing has yet been done. Some work will be attempted on them another season.

A brilliant red Infusoria, an *Englena* whose specific name now escapes me, I found in August, on a wet mud flat by a shallow pool in Waubaunsee County, in such multitudes as to make a considerable area to appear as though coated with blood. Until within a few years this genus was regarded as a plant. It is not, however, the expectation to undertake much with the Infusoria, as these are so largely cosmopolitan in their distribution.

In Botany the survey has concerned itself with the Cryptogams only. A number of botanists are diligently at work with the flowering-plants, and it is understood that no less than four of these propose to give us independent accounts of the phænogamic flora of Kansas. Further work on the Phænogams is therefore uncalled for.

In the Ferns, collections have been made and two papers published which have added a number of names to the record of Kansas species. Amongst these I may mention the luxuriant Marsh-Fern (*A. Thelypteris*), contributed from Pottawatomie County by Mr. A. McMillan, and the Hardy Lip-Fern (*Ch. lanuginosa*) and the Wright Cliff Brake (*P. Wrightiana*), contributed from Ottawa County by Mr. C. C. Olney. The species and varieties of ferns known to occur in Kansas now number twenty-four.

In Mosses, Fresh-water Algæ, and Lichens, lists have been begun, though the number of species recorded is small, compared with what are yet to be recorded. Among the Algæ, after the large green scûms of matted threads (*Spirogyra, etc.*) common in pools and watering-troughs, the most conspicuous is perhaps what may be called the "Swimming-bell Alga" (*Glœotrichia natans*,) which was found in Lake Inman in August, and which seems not to have been previously detected in western North America. The gelatinous frond of this plant has at first the form of an inverted saucer or shallow cup, with margin rolled in beneath. After this has attained a length of two or three inches it sends out long finger-like lobes and becomes very irregular in form, the entire plant sometimes attaining a length of two or three feet. The resemblance in general habit of the young "blubber-cups" to certain of the curious jelly-fish known to the mariner as "sea-blubbers" at once suggests itself, though we must not look for tentacles nor scrutinize in any way too closely; and, as they float in the open spaces left by the confused colony of brown, long-fingered, older fronds, it is easy to fancy them such, floating among the sea-weeds of some quiet bay. Thus do the insignificant lakelets of the plains in the heart of a great continent simulate scenes of the ocean.

In Fungi, the survey has collected over two hundred species, mainly non-parasitic, of which nearly all have been reported in the *Washburn Bulletins*. In this department of the work, Prof. W. A. Kellerman of the State Agricultural College coöperates and has reported about one hundred eighty species of parasitic fungi and thirty-two miscellaneous. Making allowance for the few species

common to these lists, the number of fungi thus far determined in Kansas is about four hundred, a considerable number among them new to science. The number of perishable fungi collected but not determined would doubtless double this number; and the number of fungi that occur in the State is probably not short of two thousand.

Such are some of the results that up to this time have been gained toward the development of the knowledge of the botany and zoölogy of Kansas. Much remains to be done and it is hoped that the aid of every observer in Kansas will be heartily extended to the survey so that the results, based upon an abundance of material, may be full and conclusive; a credit alike to the collaborators and to the State.

ASTRONOMY.

VELOCITY.—III.

EDGAR L. LARKIN.

MOTION IN THE SIDEREAL STRUCTURE.—In (I), this REVIEW, Volume VII, page 764, we presented the fact that a body falling on a straight line from an infinite distance to the Sun, not meeting resisting medium, will strike with a velocity of 382.956 miles per second. This is the maximum velocity that can be imparted to a falling mass by the attraction of the Sun and in these notes is termed G. It is the most valuable constant in nature yet detected by mathematicians. By its use, rates of motion generated by solar gravity in the remotest solitudes of space can be computed with little work.

Since G=velocity of impact or the Sun from infinite distance, terminal motion from any finite distance can be determined with ease by means of G in simple formulas. On page 766 we made calculation of velocities of collision from several finite distances ranging between 1 and 20,000,000 solar radii. Because it is difficult for cosmic masses to strike the Sun, few collide while many dash around it on orbits, we gave (Volume VIII, page 188,) velocities of bodies that escape collision and retreat to interstellar voids. These discussions relate to motion displayed near the Sun; but we desire to make research on velocities observed in that small part of the sidereal edifice visible in telescope.

Assume a stone at rest at an infinite distance from the Sun, and let it fall on a straight line, then since we know G, the velocity of the falling body while passing a point at any finite distance can be determined by making G a factor.

Thus:—if a mass from infinite distance approach the Sun, its velocity at any finite distance expressed in solar radii is equal to G multiplied by the square root of the quotient obtained by dividing the distance by its square. If we call

the radius of the Sun r, the Earth's distance is 214r, whose square =45972. Then—214÷45972=.046638 whose square root=.06829×382.956=26.15 miles per second velocity acquired by the mass at the orbit of the Earth on arrival from a distance that is infinite. Solar gravity acts on all cosmical bodies, which would move toward the Sun unless restrained by an opponent able to counteract attraction. Such energy is centrifugal tendency, a tendency generated by velocity. It is known how great orbital motion is required to evolve centrifugal tendency equal to gravity at any distance; hence the ratio of such velocity to velocity derived from fall from infinite distance can be ascertained.

Having found this ratio, it can be extended to any depth of space, and motion computed. If a body revolve around the Sun with velocity sufficient to cause centrifugal tendency to equal centripetal, such velocity is equal to G multiplied by the square root of the quotient obtained by dividing the distance at which it revolves by *twice* its square. We have for the motion of the Earth—twice the square of 214=91945, when 214÷91945=.002332 whose square root =.0483× 282.956=18.49 miles per second orbital velocity necessary to keep it from fall-toward the Sun. But, 26.15÷18.49=1.414213, hence the sought for ratio of orbital velocity at a distance of revolution where such motion evolves centrifugal tendency equal to gravity, is to velocity of fall ot the same distance from the Sun of a falling body that begun its fall at an infinite distance as 1 is to 1.414213.

Now, 1.414213 is the square root of 2, hence this ratio of velocities must be correct, for if we take the square roots of quotients derived from dividing a number by the square and twice the square of another, this relation of roots must inevitably obtain. This ratio may be said to be a characteristic of gravity and motion and exists wherever matter does, or is at liberty to move in obedience to gravitation. Let us again note from I and II the properties of this square root of 2. If we should dig a well from the surface to the centre of the Sun and drop in a stone, it would reach the centre with a velocity of 270.79 miles per second. But this is equal to 382.956÷2.414213, whence a mass falling from the surface to the centre of the Sun will acqure seventy per cent of the velocity attained on reaching the solar surface had it been falling since the "beginning." Again—a body taken into space distant 1 radius of the Sun and let fall, will make impact with this same velocity—270.79 miles per second. Or,—a stone a few miles above the Sun's surface (in absence of retarding matter) having orbital velocity=270.79 miles per second, will not fall but make revolution like a satellite; or should the Sun's equator revolve with that rate, masses lying upon the surface would be without weight. If a comet move with velocity equal to the square root of 2,—velocity of a planet at same distance where centrifugal tendency and gravity balance, being equal to 1, then will the comet pass round the Sun and retire never to return. Should its motion be less, say 1.38 or similar velocity, then it will fall on some form of ellipse and make future circuits. In short—velocity on closed is to velocity on open conics; or orbital velocity at finite is to velocity of fall from infinite distance as 1 is to 1.414213. We extend this principle to the sidereal heavens seeking to learn what rate of motion solar gravity

is able to cause among other suns so distant that their light requires centuries to traverse the mighty wastes between. We present this table of distances and velocities. Column I gives distances from the Sun's centre in trillions of miles, II, orbital velocities in miles per second of bodies in revolution around the Sun where centrifugal tendency equals gravity; III, same in miles per hour; IV, falling velocities acquired by bodies that fall from infinite distance, on arrival at orbits of revolving bodies; V same in miles per hour:

I. Distance.	II. Orbital Velocities, Miles per second.	III. Same, Miles per hour.	IV. Falling Velocities, Miles per second.	V. Same, Miles per hour.
1.	.1788	644.	.253	910.
5.	.0797	287.	.1125	406.
10.	.0563	203.	.0797	287.
16.	.04474	161.	.06327	228.
20.	.039	140.	.0563	203.
32.	.03163	114.	.04474	161.
40.	.02757	99.	.039	140.
64.	.0224	80.	.03163	114.
80.	.019	68.	.02757	99.
128.	.0158	57.	.0224	80.
256.	.01117	40.	.0158	57.
512.	.0079	28.	.01117	40.
1,024.	.005586	20.	.0079	28.
2,048.	.0039	14.	.005586	20.
4,096.	.00276	10.	.0039	14.
8,192.	.00195	7.	.00276	10.
16,384.	.00138	5.	.00195	7.

This table was calculated by employing G once to find falling velocity at five trillion miles as indicated in formula. This was all that was required for having falling velocity at a given distance, orbital velocity was obtained directly by dividing by 1.414213. Both velocities being known, the whole table may be made in a short time by simple division, or by proportion or by interpolating.

Thus: orbital at five, is the same as falling velocity at ten trillion miles, and so on. This must be true since velocity at a distance divided by the square root of 2 equals velocity at twice the distance, a result that obtains because gravity varies inversely as the *square* of distance. But one cannot fail being impressed with the majesty of the Sun, or his mighty power of attraction.

We see that a body distant twenty trillion miles must move with a velocity of .039 miles per second or 140 miles per hour in direction at right angles to radius vector, or it is falling toward the Sun. But twenty trillion miles is the distance of Alpha Centauri, the nearest star. Ignoring the mass of Alpha Centauri let us call it a material point, then it has this velocity which is at a minimum, and its path is curved this way. This follows unless indeed, there is on the other side

of Alpha a Sun more massive than our own. If there is, then Alpha of the Centaur does not traverse a path of *regular* curvature. Neither does any other Sun owing to mutual attraction. Assigning to the nearest sun to ours a mass equal to the solar, assume our Sun to dwindle to a point, then *its* minimum velocity is 140 miles per hour.

Continuing research, let us recede to forty trillion miles, when we find that a mass there must move on an orbit ninety-nine miles per hour or fall toward the Sun. Seeking to escape solar gravity we sink in space to the appalling depth of 13,384 trillion miles, when behold! we still are dominated by his colossal power. Indeed! a sun at that distance of must fly on a gigantic curve five miles per hour or yield to solar force and fall. Or, having reached that point from infinite distance its falling velocity would be seven miles per hour. Light requires 2,880 years to traverse 16,384 trillion miles. But, a sun at that distance may not obey ours, its varying path may be determined by others nearer or more massive, and by none of these long at a time, since all suns shift position. Some suns are seen to move with greater velocity than theory demands, hence let us make further research in this exciting field.

NEW WINDSOR, ILL., January, 1885.

CAUSE OF SOLAR HEAT.

PROF. RICHARD A. PROCTOR.

Professor Young, of Princeton, in a recent address at Philadelphia, expressed his belief that the contraction theory of the sun's heat is the true and only available theory. I believe so, too, and my object in the present paper is to dwell upon the significance and interest of this remarkable interpretation of the solar mechanism.

Of course it is known to all that the old theory according to which the sun's heat is due to combustion ("doubt that the sun is fire," said Shakespeare, as if the doubt was the quintessence of absurdity) has long since been rejected as futile. A mass of the best combustible material, equal to the sun in quantity, would be burned out at his actual rate of emission—if it could burn right out—in about five thousand years. In like manner the idea of the sun as an intensely hot body simply radiating its heat into space, as a piece of white-hot iron does, without any process of combustion, has had to be rejected. Even if the sun were formed of matter possessing the high specific heat of water which has the remarkable property of giving out more heat in cooling than any other natural substance known (and only one or two artificial substances surpass it in this respect), even then the sun's emission of heat at his present rate would not cover more than about 5,500 years. Processes of chemical change have been suggested as affording the true source of solar heat; but they in turn have had to be rejected as altogether insufficient. It is unnecessary to touch on the supposed origin of solar heat in the

gathering in of meteoric bodies, for in reality this process belongs to the contraction theory; it has, however, been abundantly demonstrated that the actual amount of sun heat which could be derived from the drawing in of matter now outside the solar globe can be but very small. We are left, in fine, no recourse—so far as our present knowledge extends—but to regard the process of contraction taking place within the solar globe as the true source of all or very nearly all the heat and light which the sun emits, and therefore of every form of force and life on this earth and on whatever other members of the solar system may be the abode of life or a scene of the display of any forms of force not derived from internal heat and energy.

But now at the very outset, what a mighty mystery is thus unveiled! It seemed wonderful enough to recognize in what we fondly call inert matter the source of the energies which guide the heavenly bodies in their motions. I know indeed nothing more mysterious (more hopelessly mysterious, one might say, if one could limit the possibilities of future research) than the mystery of gravity. It has been said, and truly said, that

> Nature and Nature's laws lay hid in night,
> God said, "Let Newton be," and all was light.

All was indeed light where before men had been groping in darkness. But outside the region where they had thus been searching, far vaster regions of darkness were revealed. A veil was lifted and one of nature's mysteries was interpreted, but a more impenetrable veil was seen beyond, which as yet no man has even hoped to lift. What greater mystery can there be than this, that matter acts where it is not? The sun on the earth and all his planets, the earth on the moon, Jupiter and Saturn on their world systems, planet on planet, star on star, nay, every particle of matter on every other throughout infinity of space. And not only so, but time apparently annihilated as well as distance. For it has been shown that unless the force of gravity traversed distance with far greater velocity, nay, with many times the velocity of light (187,000 miles per second), the whole mechanism of the solar system would long since have gone wrong. Nor has it yet been shown how minute the time intervals are in which practical infinities of distance are traversed by this all-pervading attractive action.

And now we find that not only is "inert" matter thus intensely, one may say infinitely, energetic, as a cause of motion, but that it is the real source of the light and heat, which are in effect the very life of the universe itself. Within our own earth, the movements we call earthquakes, as well as all such disturbances as volcanic eruptions, geysers, and so forth, are all primarily due to the process of steady contraction taking place under the action of terrestrial gravity, though of course the proximate cause of each such disturbance is the heat generated during the process of contraction. In each planet, no doubt, similar processes are taking place, with greater or less energy according as a planet is younger or older. And now we see the mighty mass of the sun, steadily by its gravitating energy gene-
t, whose emission is in fact the very life of the solar system. In other

words, there resides in mere matter, in what we have so long and so idly called inert matter, the real source of every kind of movement, of every kind of life, within the universe itself. For, what is true of our sun is true of his fellow suns, the stars; not only of the thousands we see, but of the tens, the hundreds of millions revealed by the telescope, and of the millions of millions of galaxies of suns which doubtless exist beyond the domain surveyed by our most powerful telescopes.

But, turning from this stupendous, one may truly say, this awful mystery, which seems to present gravitation as in a sense associated directly with the great first cause, we note that there are many minor mysteries about the theory that solar gravitation is the true source of solar heat.

In the first place, many find it difficult to understand how the shrinkage of even solid matter, still less that of vaporous matter, can lead to the generation of heat. Yet in reality, to any one who rightly apprehends the principle of the conservation of energy, it will be obvious that the heat generated as the solar gravity draws inward any portion of his envelope of vapors, and in so doing necessarily diminishes the volume of that portion, must be exactly the equivalent of the heat which would be required to reverse the process, and so to restore by expansion that portion of vaporous matter to its original volume. A real difficulty arises for a moment when we inquire why the heat generated momentarily by the forces tending to produce contraction is not momentarily employed in producing equivalent counter expansion. We must remember, however, that a portion of the heat generated must necessarily be radiated away into space, simply because it is exposed to the cold of space. One may compare the case to that of a pump so constructed that if all the water raised remained in a certian vessel round the place of exit, the weight of water would serve as a source of power to keep the pump working. In such a case, were friction entirely gotten rid of, the pump would work forever. But if the vessel were perforated so that all the time a portion of the water escaped, this would no longer happen. The heat constantly generated by the enforced process of solar contraction does in part escape; a portion continually undoes part of the work of contraction by causing expansion, but the portion which, as we see and feel, is continually escaping from the sun, causes a portion of the contraction to remain uncompensated. Thus the sun, as a whole, continues steadily contracting and steadily emitting heat. Nor will he cease to contract until he ceases to emit light and heat, or in other words, until he ceases to be the beneficent light-giving center of the solar system.

But the most perplexing mystery in connection with the contraction theory of the sun's heat is that the sun and the earth seem to tell a different story in regard to the amount of heat which has been poured forth. Judging from the sun's apparent size, it would seem as though not more than 20,000,000 of years of solar work, at the sun's present rate of working, could possibly have been done; for if he had gathered in his mass from any distances, however large, that would be the absolute maxim of energy represented by the process of contraction to his present apparent size. But the earth's crust seems to tell us of a much

longer period of sun work than this. If Dr. Croll, of Glasgow, whose results Sir Charles Lyell accepted, has rightly estimated the amount of work so done on the earth, it can not represent less than one hundred millions of years of sun work. How can we explain the discrepancy? Prof. Young accepts the sun's evidence as it stands, making only the provision that if in past ages the sun was exposed to some violent shock, as by collision with another sun, more heat would have been generated. Dr. Croll takes the earth's evidence alone, and considers that there must have been such collision. For my own part, I consider it clearly proved in other ways (and it comes in well to remove this particular difficulty) that the sun's real globe is very much smaller than the globe we see. In other words, the process of contraction has gone on further than, judging from the sun's apparent size, we should suppose it to have done, and therefore represents more sun work. According to this view, however, the sun's future would last many millions of years less than it would if his apparent size is not far from his real size. But the limited allowance of future work we should assign to him—a few millions of years' work at the outside—is estimated on the assumption that only such densities as we recognize in terrestrial substances can be attained within the sun's mass. It may well be that under the conditions there existing, matter may attain densities far greater than we find here. If so, the sun's duration as the life-giving center of a family of worlds may be far greater than has hitherto been supposed.—*New York Tribune.*

SUN AND PLANETS FOR FEBRUARY, 1885.

W. DAWSON, SPICELAND, IND.

The Sun's R. A. at noon, February 1st, is 21h. 2m.; and Declination 16° 54′ S., making the day about fifty minutes longer than December 31st, when the Sun's Declination was 23½° S. Spots on the Sun were few and small in the first half of January. Two pretty good-sized ones near east edge on the 17th.

The planet Saturn occupies pretty nearly the same place among the stars that it did in December and January—rather more west. Its retrograde motion continues very slowly till the 16th, when it assumes the eastern, or direct, motion of R. A. The ring is now about its widest and will continue so with little diminution for several months. It souths at 8:16 P. M. on the 1st, and at 6:30 on the 28th.

Jupiter rises at 7:00 P. M. on the 1st, some north of east. It is very bright and can easily be known from any other star: Regulus in the Sickle is a few degrees above this planet. They will be near together in latter part of March. piter will be in opposition to the Sun on the 19th of February, and its motion etrograde, which accounts for its approach to Regulus.

Any person having a telescope, or even a spy-glass, will be interested in ob-ving this great planet with its moons and belts, now it is so near us in the

evening. Mars comes in conjunction with the Sun (on the other side) in the morning of the 11th.

Venus is still a low Morning Star away southeast. Mercury will be just south of it on the 11th. Uranus is still between Eta and Gamma Virginis. Neptune is nearly where it has been for several months, a few degrees southwest of Pleiades.

METEOROLOGY.

METEOROLOGICAL SUMMARY FOR THE YEAR 1884.

PROF. F. H. SNOW, UNIVERSITY OF KANSAS.

The most notable features of the year 1884, as observed at Lawrence, were the low mean temperatures of the spring, summer, and winter months; the high mean temperature of the autumn months; the very large rainfall, which came within half an inch of the extraordinary precipitation of the year 1876; the unusual percentage of cloudiness; the low velocity of the wind; the decided preponderance of south winds over north winds; and the increased percentage of atmospheric humidity.

TEMPERATURE.—Mean temperature of the year, 51.30°, which is 2.11° below the mean of the sixteen preceding years. The highest temperature was 98°, on July 8; the lowest was 21.5° below zero, on the 5th of January, giving a range for the year of 119.5°. Mean at 7 A. M., 45.69°; at 2 P. M., 59.40°; at 9 P. M., 50.04°.

Mean temperature of the winter months, 24.19°, which is 5.71° below the average winter temperature; of the spring, 51.41°, which is 2.41° below the average; of the summer, 73.05°, which is 3.05° below the average; of the autumn, 56 59°, which is 3.01° above the average.

The coldest month of the year was January, with mean temperatûre 20.99°; the coldest week was January 1st to 7th, mean temperature 0.07° below zero; the coldest day was January 5th, mean temperature 12° below zero. The mercury fell below zero fourteen times, of which seven were in January, one in February, and six in December.

The warmest month was July, with mean temperature 76.93°; the warmest week was July 20th to 26th, mean 79.66°; the warmest day was July 8th, mean 80.37°. The mercury reached or exceeded 90° on twenty days (one less than half the average number), viz., two in June, ten in July, three in August, and five in September.

The last hoar frost of spring was on April 24th; the first hoar frost of autumn

was on October 8th, giving an interval of 167 days, or nearly six months, entirely without frost. The average interval is 154 days.

The last severe frost of spring was on April 8th; the first severe frost of autumn was on the 23d of October; giving an interval of 198 days, or nearly seven months, without severe frost. The average interval is 199 days. No frost during the year caused damage to crops of grain and fruit. The low temperatures of January were generally destructive to peach buds.

RAIN.—The entire rainfall, including melted snow, was 43.70 inches, which has been but once exceeded on our seventeen years' record (in 1876) and is 9.05 inches above the annual average. Either rain or snow, or both, in measurable quantities, fell on 115 days—eleven more than the average. On nine other days rain or snow fell in quantity too small for measurement.

There was no approach to a drouth during the year, the longest interval without rain in the growing season being thirteen days, from July 30 to August 12.

The number of thunder showers was thirty-five. There was but one light hail storm during the year—on May 17th.

SNOW.—The entire depth of snow was 29 inches, which is 8.62 inches above the average. Of this amount twelve inches fell in January, two inches in February, one inch in March, six inches in April, one and a half inches in November, and six and a half inches in December. Snow fell on twenty-one days. The last snow of spring was on April 21st; the first snow of autumn was on November 18th—ten days later than the average date.

FACE OF THE SKY.—The mean cloudiness of the year was 47.56 per cent, which is 3.09 per cent above the average. The number of clear days (less than one-third cloudy) was 146; half clear (from one to two-thirds cloudy) 116; cloudy (more than two-thirds) 104. There were seventy-five days on which the cloudiness reached or exceeded 80 per cent. There were thirty-three entirely clear and forty-three entirely cloudy days. The clearest month was October, with a mean of 34.19 per cent; the cloudiest month was December, mean 66.34 per cent. The percentage of cloudiness at 7 A. M. was 53.89; at 2 P. M., 49.76; at 9 P. M., 39.03.

DIRECTION OF THE WIND.—During the year, three observations daily, the wind was from the south-west, 266 times; north-west, 252 times; south-east, 201 times; north-east, 197 times; south, 76 times; north 46 times; east 37 times; west 23 times. The south winds (including south-west, south, and south-east), outnumbered the north (including north-west, north, and north-east), in the ratio of 543 to 495.

VELOCITY OF THE WIND.—The number of miles traveled by the wind during the year was 131,188, which is 7,421 miles below the annual average for the eleven preceding years. This gives a mean daily velocity of 358.44 miles and a mean hourly velocity of 14.93 miles. The highest hourly velocity was 75 miles,

on June 25th; the highest daily velocity was 990 miles, on the 19th of January; the highest monthly velocity was 14,368 miles in January. The three windiest months were January, March, and April; the three calmest months were June, July, and August. The average velocity at 7 A. M. was 14.62 miles; at 2 P. M., 16.91 miles; at 9 P. M., 14.27 miles.

BAROMETER.—Mean height of barometer column, 29.111 inches, which is 0.006 inch above the annual mean. Mean at 7 A. M., 29.133 inches; at 2 P. M., 29.091 inches; at 9 P. M., 29.109 inches; maximum, 29.881 inches, on January 4th; minimum, 28.451 inches, on March 27th; yearly range, 1.430 inches. The highest monthly mean was 29.333 inches, in February; the lowest was 29.002 inches in April. The barometer observations are corrected for temperature and instrumental error only.

RELATIVE HUMIDITY.—The average atmospheric humidity for the year was 72.6; at 7 A. M., 83.1; at 2 P. M., 55.8; at 9 P. M., 78.8. The dampest month was September, with mean humidity, 77.8; the dryest month was March, mean humidity, 65.0. There were twenty-eight fogs during the year. The lowest humidity for any single observation was 15 per cent, on March 12th.

The following tables give the mean temperature, the extremes of temperature, the number of inches of rain and snow, the number of rainy days, the number of thunder showers, the mean cloudiness, the relative humidity, the number of fogs, the velocity of the wind, the mean and extreme barometer heights for each month of the year 1884, and a comparison with each of the sixteen preceding years:

YEAR 1884.

1884.	Mean Temperature.	Max. Temperature.	Min. Temperature.	Rain—Inches.	Snow—Inches.	Rainy Days.	Thunder Storms.	Mean Cloudiness.	Mean Humidity.	Number of Fogs.	Miles of Wind.	Mean Barometer.	Max. Barometer.	Min. Barometer.
January	20.99	57.0	-21.5	1.28	12.0	7	0	41.42	73.9	3	14,368	29,313	29,881	28,735
February	28.03	57.0	− 1.0	1.13	2.0	8	1	54.33	72.3	1	11,651	29,158	29,469	28,557
March	41.56	73.0	12.0	2.73	1.0	9	5	58.87	65.0	2	14,229	29,054	29,465	28,451
April	50.42	76.5	28.5	5.62	6.0	13	4	55.76	65.9	1	13,954	29,001	29,321	28,495
May	62.24	85.0	36.0	3.57	0.0	12	2	50.54	68.9	2	9,978	29,046	29,299	28,689
June	71.07	92.0	48.0	3.81	0.0	12	7	38.78	71.8	1	6,806	29,065	29,270	28,831
July	76.93	98.0	60.5	5.18	0.0	15	5	41.67	71.7	1	8,733	29,004	29,289	29,809
August	71.14	92.5	47.5	5.49	0.0	11	4	48.16	77.8	3	9,392	29,110	29,405	28,849
September	70.36	92.0	48.0	9.15	0.0	8	5	40.00	76.3	3	11,409	29,037	29,404	28,810
October	57.87	85.0	31.0	2.38	0.0	8	2	34.19	74.8	5	10,150	29,179	29,568	28,712
November	41.53	70.0	9.5	0.80	1.5	3	0	40.77	72.0	5	10,503	29,175	29,563	29,634
December	23.54	59.5	6.5	2.56	6.5	9	0	66.34	80.0	1	10,015	29,189	29,666	28,618
Mean	51.30	78.1	25.4	3.64	2.4	10	3	47.56	72.6	2	10,932	29,111	29,467	28,685

SEVENTEEN YEARS: 1868—1884.

Year.	Mean Temperature.	Max. Temp.	Min. Temp.	Hot Days (above 90°.)	Zero Days.	Days between severe frosts.	Rain—Inches.	Snow—Inches.	Rainy Days.	Thunder Storms.	Mean Cloudiness.	Mean Humidity.	No. of Fogs.	Miles of Wind.	Mean Barometer.
1868..........	53.36	101.0	-16.5	43	7	160	37.48	27.50	77	.....	42.35	......	.....	....	....
1869..........	50.99	96.0	- 5.0	23	2	167	38.51	18.00	105	33	49.23	78.2	19	....	29.103
1870..........	54.50	102.0	-10.0	51	6	197	31.32	9.50	100	27	47.88	68.4	13	....	29.097
1871..........	54.30	103.0	- 6.0	48	8	218	33.23	29.75	120	24	47.37	65.9	6	....	29.076
1872..........	51.90	97.0	-18.0	45	16	192	32.63	23.25	116	40	44.33	64.4	11	....	29.112
1873..........	52.71	104.0	-26.0	48	9	165	32.94	26 50	101	17	42.46	64.0	6	154,508	29.093
1874..........	54.20	108.0	- 3.0	58	2	187	28 87	43.00	99	20	45.54	65.7	14	145,865	29.121
1875..........	50.60	99.0	-16.5	32	12	196	28.87	5.00	106	21	44.81	66.7	5	145,316	29.102
1876..........	52.76	98.0	- 5.0	36	4	179	44.18	25.75	102	29	41.27	66.8	4	148,120	29.102
1877..........	54.16	99.0	- 9.0	20	3	217	41.09	15.50	126	39	47.12	72.6	11	113,997	29.117
1878..........	55.33	98.0	- 6.0	35	7	228	38.39	25.50	107	38	40.65	70.2	5	125,793	29.067
1879..........	54.67	99.5	-16.0	48	13	203	32.68	10.35	90	36	40.01	67.1	10	124,758	29.127
1880..........	54.01	101.0	-12.0	41	2	211	32.65	7.00	89	29	40.15	67.9	18	146,039	29.123
1881..........	54.65	104.0	- 8.0	68	6	210	33.27	32.50	110	31	47.42	70.1	11	141,430	29.103
1882..........	54.94	105.0	- 6.5	40	1	232	27.60	18.00	102	26	45.41	68.6	14	137,736	29.113
1883..........	51.66	96.5	-14.0	26	8	217	40.65	12.50	106	32	45.24	69.7	18	141,164	29.135
1884..........	51.30	98.0	-21.5	20	14	198	43.70	29.00	115	35	47.56	72.6	28	131,188	29.111
Mean..........	53.29	97.8	-12.8	41	7	199	35.18	20.87	104	30	44.65	68.7	12	137,591	19.106

In the column of minimum temperatures a dash indicates temperature below zero.

CORRESPONDENCE.

THE NEW ORLEANS EXPOSITION.

EDITOR REVIEW:—The Christmas holidays gave our city teachers a much needed vacation, which was improved by about forty of us in visiting the New Orleans Exposition. Of course we went by way of the Memphis Short Line, with buffet sleepers the whole distance. As the ground was covered with snow and ice, and the mercury only barely above zero when we started, little can be said of the picturesqueness of the scenery, the charms of the climate or the verdure and productiveness of the soil along the route, either in Kansas, Missouri or Arkansas. At Memphis we found the Mississippi full of heavy floating ice, and from that city for the greater portion of the way to New Orleans old winter had locked everything up in icy bonds, so that so far as appearances went the "Sunny South" had fully acknowledged his sway. A few holly-trees, some pines, some canes, and, as we approached the Gulf, some magnolias and live-

oaks, retained their green foliage, otherwise all the trees were as bare of leaves and the grass as dead as in the North.

Cotton fields here and there, half picked, broke the monotony of dense forests and canebrakes; farm houses and cabins showed themselves at long intervals; towns and villages were almost unknown; the railway stations were mostly single shanties without even the accompaniment of the universal saloons and eating houses; animal life was scarce, and as for people, it was a wonder, as one of our professors said, where the South, if this was a sample of it, found the men to make the resistance it did to the march of our armies in the late war. The morning of our arrival in New Orleans found us amid sugar plantations, orange groves, blooming roses, well advanced gardens, barefooted negroes and other signs of a tropical climate. The weather was warm, but the air was moist and murky.

About 9:00 o'clock we rolled into the city, passing over miles of low, flat, swampy outskirts with grassy streets cut into miry channels by the teams plunging through them. On the right we could see the Exposition buildings in the distance, with the chimneys and even the hulls of the steamers on the river beyond looming up high above the intermediate territory. On the left more swamps with palmettoes, moss-burdened oaks and cypresses, and tangled vines, extending clear to the margin of Lake Ponchartrain. In front, mud, smoke, white frame houses with enormous double porticoes, negroes, oranges, bananas, French women, blooming dooryards with high close fences, and ditches full of filthy water, made up the landscape. At the depot we took carriages and omnibuses and were jolted to our hotel over the roughest streets imaginable. If any one of our readers was ever sick while in the army and compelled to ride in a government wagon over the corduroy roads of Virginia, he will have a pretty good idea of this closing ride, otherwise he cannot, as nothing else ever equaled it for discomfort. The paving of the streets, where any has been done, consists of blocks of stone of uneven sizes and shapes, with—apparently—an omission of every other one.

While growling, I may as well say that if disease really does ever come from dirt there should not be a well ~~known~~ person in New Orleans at present, for it is impossible to conceive of streets more utterly foul and filthy. Not only is there an unmeasureable vastness of mud, hardly barred off from the sidewalks by the curbstones, and swashed along sluggishly by the oozy torrents in the gutters, but every butcher, baker, saloon-keeper, etc., who has a bucket of slops to dispose of brings it to the edge of the sidewalk and pitches it into the middle of the street. You have mud in Kansas City, but it is so clean compared with New Orleans mud that you could absolutely cleanse yourself in it after wading about in the latter for an hour or two. Inasmuch as I learn that this city is quite healthy now, I am prepared to discard the theory that dirt has anything to do with originating disease, and propose to protest against our Dr. Fee's sanitary precautions as unnecessary and possibly baneful.

Having said so much in disparagement of this city, I will now say something

to its credit. I had heard much of extortionate rates for rooms, board, meals, etc., but after a week's stay I can candidly say that I have found nothing of the kind. The hotel charges remain as formerly, from five dollars a day down to two and one-half, according to style, location, etc. No one need pay out more than three dollars per day for very comfortable living, with room to himself and meals at a French restaurant. With economy and by doubling up in rooms, this figure can be considerably reduced. One can go out to the exposition grounds—four miles—on a steamboat at twenty-five cents for the round trip, landing at the side entrance to the grounds, or on the street cars for five cents each way, getting off at the main entrance. He can ride out to Lake Ponchartrain on the steam cars by two routes, five miles or more, for twenty cents the round trip, or he can, if he is as lucky as the teachers of the northwest, take an excursion to Mobile and back, with a stop at Jeff. Davis' place, Beauvoir, and a fish dinner at Pass Christian, for two dollars; or he can take a steamer down to the Jetties and back with a sail on the Gulf, for six dollars, including berth and meals on the boat for twenty-four hours; so that you see the rates are not so very exhorbitant after all.

As to the city, it is much like all other cities. Among its curiosities are the old French town and the French market, the levee with its shipping from all parts of the world; its cotton exchange, its shot tower, cathedral, etc.

Now for the Exposition. So much has been written about it that one hardly knows what to say that will be new. Everybody knows that it is located on the flats above the city, and that one hundred and seven acres are inclosed for its uses and purposes; that the main building covers thirty-three acres of ground, and that about two millions of dollars have been expended upon it and the other buildings. These things are well known and yet the people who know them may not realize how large this main building is. It might astonish some of them to appreciate the fact that it is as large square as from 8th to 12th Street in Kansas City, or that the music hall, large enough to seat 11,000 persons on one floor, may be passed unnoticed day after day, although nearly in the center of the building, if you happen to enter by any other than the grand front door. Constructed of glass and iron, it is both light and strong, and as a grand architectural work it is an admirable and marvelous success. It, as well as the government building, is the work of a Swedish architect named Torgerson.

The management of the whole affair, from its conception to the present day, has been concentrated in the person of Major A. E. Burke, editor of the *Times-Democrat*, of New Orleans. He has done in less than one year and with $2,000,000, what the Philadelphians were glorified for accomplishing in four years with more than three times as much money. He has put his whole soul into it and, for that matter, his body too, for he has worn himself out more in these few months than he would have done in ordinary business in as many years. As a man who knows something about expositions, in a small way, I pronounce the management of this New Orleans affair a wonderful success. The delays and indrances are less noticeable than usual, in proportion, and are due far more rgely to the lethargy of the citizens of the city and of the people of the South,

who are chiefly to be benefitted by it, than to any other cause. They could and should have put their money into it liberally; at least they should have paid up their voluntary subscriptions—and not have allowed its credit to be destroyed before its completion; they should have provided better means of access, both for freight and visitors, and they should patronize it better themselves.

But even as it is, it is a better exposition in many respects than this country ever saw. Any visitor who undertakes to see all that is even now well presented —omitting all unfinished exhibits—in one week will fail to do it justice. Any visitor who is interested in any special subject and desires to study it in detail, can spend days on that alone, whether it be ores, minerals, products of the soil, manufactured articles, natural history, archæology, machinery, inventions, art, educational facilities, or progress and results in any other line. Every State and Territory is fully and excellently represented in all these respects, and while some few are yet in an unfinished condition, it is the verdict of all who visited it that these exhibits far excel in size and manner of arrangement those at the Centennial at Philadelphia in 1876. To be personal and candid, I will say that Nebraska seems to take the lead of all in the magnitude and the tastefulness of her display, while Kansas comes next. Missouri has a striking array of packing-boxes, barrels, bales, etc., besides a quantity of freight yet remaining at the depots, which when arranged as contemplated will be highly creditable to Major Hilder and his assistants. Of course the $2,000 or $3,000 raised for this purpose, mainly in St. Louis, will not enable them to make much of an effort to compete with States whose legislatures and private citizens furnished their commissioners with from $5,000 to $25,000 to give an adequate representation.

The display by the Interior and other departments of the Government is absolutely superb, and one who has not visited the Patent Office, Smithsonian Institution, Bureau of Education, Coast Survey, Signal Office, Agricultural Department, Post Office Department, National Museum, Fish Commission, etc., will be fully repaid by these alone for a trip to New Orleans. I am not certain that he will not be better satisfied here, because he can see the best items of all these collections, all under one roof, and thus avoid the fatigue of looking them up in buildings scattered all over Washington City.

If he has a taste for natural history, not fully gratified by the specimens in the Government and State displays, he can step into the gallery and there find the vast collection of Prof. H. A. Ward, of Rochester, which is unequaled in the country. In this he will find restorations and casts, life-size, of the mammoth or fossil elephant, the *Glyptodon clavipes*, the *Megatherium*, the *Mylodon robustus*, and the Irish Elk, besides skeletons, beautifully articulated and mounted, of man and all the Simian family, side by side; birds, fishes, reptiles, etc. Many of these cannot be seen elsewhere in the United States, and Prof. Ward has never before drawn so largely upon his museum for an outside exhibition.

In the main building other nations besides the United States are represented, such as Mexico, Turkey, Honduras, Japan, etc.

To those who are fond of machinery we commend Division B, an iron exten-

sion of the main building, 600x220 feet, filled with machinery for picking, ginning and pressing cotton and also wood-working machines; beyond this another vast room 600x60 feet for heavier machinery, such as saw-mills, etc. Adjoining this, in the main building, are found all kinds of milling machinery; also the exhibits of the Willimantic, Coates, Clark, and Whitin spool cotton companies; the first-named occupying seventeen spaces, or about 200 feet, with the various machines employed in manufacturing spool thread, all in full operation, with crowds of interested spectators watching the successive processes the cotton passes through, from the raw staple to the spooled thread. Near by are the Corticelli Silk Company's headquarters, where can be seen everything connected with the manufacture of spool silk, from the silk-moth, the egg, the silk-worm the cocoon, the reeling of the silk from the cocoon, the spinning, winding, the to coloring, spooling, etc.

Going back to the machinery, we find nearly in the center of the main building the motive power which keeps all the other machinery, as well as the dynamos for the electric lights and electrical display in motion. Principal among these engines is the huge Corliss engine set in operation on the opening day by an electric signal from President Arthur from his room in the White House; but there are nearly a dozen others, aggregating over 4,000 horse-power, grouped together in that locality. Near these is a wonderful display of sugar machinery, railroad engines and cars of all kinds and other heavy machinery, including some very old-fashioned locomotive engines and an electric railway of the most recent date. The ice machines are by no means the least interesting objects, especially to the people of the south, and there are specimens of several patterns, besides refrigerators in all styles and sizes.

In agricultural machinery the display is comparatively light, and I think that I have often seen more of all kinds on exhibition at the Kansas City Expositions.

The electric light is a success. Most of the principal companies of the country are employed to furnish light, such as the Brush, the Edison, the Fort Wayne, and a home company. Thousands of electric lamps, inside and outside of the buildings, give ample light for all purposes, so that visitors who can not go out in the day time can see just as well at night. The Brush Company have the lighting of the government building where the National and State exhibits are displayed, and employ six of their largest dynamos for generating the electricity needed for the 3,600 lights furnished. The Edison Company light the Main Building and Agricultural Hall with over 4,000 incandescent lamps, and have twelve dynamos operated by six engines of 125 horse power each, with a capacity of over 6,000 lights. When the Art Hall is finished this company is to light that also. The Fort Wayne Company light the outside towers—about ten in number —including those at the entrance to the grounds and buildings, also the sheds, stables, etc. These towers are very handsome, being light, ornamental in appearance, and very strong. One of them, placed at the "Lake," is of 100,000 candle power—said to be the largest single electrical light in the world. The home

(Louisiana) Company furnish 800 arc lights in the Main Building. Collectively, this electric system is the largest ever in operation.

Among the myriads of objects of interest, one which attracted my attention and excited my interest, was a white bronze statue, about fifteen feet high, of a private soldier on his post, musket in hand, intended for either street, park, or cemetery purposes. It is admirably done, both in conception and execution, and I should like to see it placed on one of our principal crossings—say at the junction of Main and Delaware streets, at Ninth. It would be an appropriate thing for our citizens and the Grand Army to do, and it can be done for not exceeding $2,000.

Among the things for which Missouri may claim credit, is the time ball, constructed and put in operation by Professor H. S. Pritchett of Washington University, St. Louis. Every day at 10 A. M. this ball is dropped from the principal tower of the Main Building, the closing of the circuit being made by the standard clock at the observatory of Washington University, 700 miles away, to the exact fraction of a second in correctness. All the clocks in the building are kept uniform by the same signal.

Two of the States, viz., Florida and New Hampshire, present topographical models of their surfaces and shapes on a very large scale—perhaps fifteen by thirty feet—so that most of their physical features can be readily seen at a glance, while all of the States have most complete collections of their peculiar natural and artificial productions, artistically displayed.

The ethnological displays made by the Geological Bureau are most interesting, and include, as stated in the last issue of the Review, products of aboriginal art, both ancient and modern, such as textile fabrics, pottery, implements of war, and the chase, and other curious objects connected with their religious ceremonies and festivities. The models of the Cliff-dwellings and of the pueblos of prehistoric and existing tribes from New Mexico, Colorado, and Arizona, are intensely interesting, and are constructed on a scale large enough to give a very fair idea of their architecture and other details. The Mound-builders, also, are fully represented by series of their implements, tools, ornaments, and other works, as well as by models of some of the most noted mounds and earth-works in the country. In fact, the $300,000 appropriated by Congress to enable the various departments of the Government to make fitting and useful exhibits at this Exposition, seem to have been most judiciously expended, and no one can fail to be gratified and satisfied with them, no matter in what subject illustrated he may be most interested.

Next month (February) doubtless everything will be in perfect order, so that then will be the most favorable time to come here, and the weather will probably be more propitious, for at present overcoat and fan are alternately and equally in demand. C.

BOOK NOTICES.

THE BOOK OF ALGOONAH: Pages 353. Cyrus F. Newcomb & Co., Del Norte, Colorado, 1884. Cloth, $2.00.

This book is given to the public with a view of throwing light on a very interesting but obscure subject. The author admits that it will probably excite a great deal of honest criticism, but claims that it contains internal evidence of its authenticity as an historical book, and assures his readers that it is formed from authentic materials. It undertakes to point out the origin and career of the Mound-builders, designates "Algoonah, their first king, describes their formation as a nation, their home in the borders of Egypt, their travels through India, Tartary, and China to the Japan Islands, their exploration of Mezzinaroth (America), their settlement of Mexico and Central America, the history of this wonderful race and their landing on this continent, etc."

Being written in scriptural and allegorical style, it is difficult to follow the writer's idea at all times, but we recommend all archæologists to examine it with care.

CATARRH, SORE THROAT AND HOARSENESS: By J. M. W. Kitchen, M. D. Illustrated. 12mo, pp. 80. G. P. Putnam's Sons, New York, 1884. For sale by M. H. Dickinson, $1.00.

This little work comprises a description of the construction, action, and uses of the nasal passages and throat, certain diseases to which they are subject, and the best methods for their prevention and cure. Dr. Kitchen is the author of another work of a similar character, entitled "The Student's Manual of Diseases of the Nose and Throat," which has been highly commended, and he has filled and is now filling several positions in the New York hospitals and colleges, which eminently fit him to write from experience upon such subjects. The descriptions are accurate, and the suggestions for treatment sensible and based upon logical grounds and practical experience. Besides instructions for home treatment of these diseases, many of the latest instruments for professional treatment are described and illustrated, with hints and suggestions for physicians.

REPORT OF THE CHIEF SIGNAL OFFICER FOR 1883: General W. B. Hazen, U. S. Army, octavo, pp. 1164. Government Printing Office, 1884.

This ponderous volume contains the report proper of the Chief Signal Officer, which occupies but eighteen pages, and the appendix, charts, etc., which are the meteorological statistics gathered from stations all over the country, the reports upon the Lady Franklin Bay Expedition, and the Relief Expedition to Point

Barrow in 1883, outline of the lectures delivered to the Signal Service Corps of students at Fort Meyer, etc.

General Hazen deplores the reduction in the appropriation for weather observations as being detrimental to the interests of the people, alleging that the demands of the country upon the Signal Service are greater than ever before, and showing the value of the weather statistics and predictions by the verifications of the latter on sea and on land. The percentage of accuracy in predictions has increased from 84.4 per cent in 1882 to 88 per cent in 1883, and of course this accuracy will still increase with any increase of stations.

In fifty-four cities, meteorological committees, to act in concert with the Signal Service, have been appointed. The popular idea that the rainfall on the Western plains has increased with the increase of railway and telegraph lines, has been exploded by careful and special observations by skilled observers and plans for systematic collection of data concerning tornadoes have been made, which observations may be of service upon being classed and generalized.

WISCONSIN HISTORICAL COLLECTIONS. Vol. IX, 1880–81–82: Wisconsin Historical Society, Madison, Wis., 1883. Octavo, pp. 498.

The energetic and capable Secretary of the above-named society, Professor Lyman C. Draper, in collecting and editing this series, is doing an important and valuable work for the State. It consists of articles upon the archæology, the early history and the progress of Wisconsin, with biographical sketches of some of its best men, such as Governor E. B. Washburn, Col. Larrabee, Judge Barron, and others. It is just such work as every State should secure before it is too late, and one which will be more and more highly appreciated as time passes.

PROGRESSIVE MORALITY: By Thomas Fowler, LL. D., F. S. A., President Corpus Christi College, Oxford. Price, post-free, 15 cents. J. Fitzgerald, Publisher, 20 Lafayette Place, New York. For sale by M. H. Dickinson.

The progress of Natural Science has been not without effect upon the data of the moral and intellectual sciences. The present work, by an author of the highest eminence, is an attempt to show wherein the principles of moral conduct are reinforced or explained by the application to Ethics of the methods of research employed in the study of nature. The author aims to present a scientific conception of Morality in a popular form, and with a view to practical application rather than to discuss theoretical difficulties. His views are in full harmony with those which, making exception for a few back eddies in the stream of modern thought, are winning their way to general acceptance among the more instructed and reflective men of our day.

OTHER PUBLICATIONS RECEIVED.

Annual Report of Missouri River Commission for 1884, from Prof. G. C. Broadhead. Meteorology of the Mountains and Plains of North America, as affecting the cattle-growing industries of the United States, by Capt. Silas Bent. *Tidings from Nature*, January, 1885, Vol I, No. 5, Rutland, Vermont. Reports from Consuls of the United States on Commerce, Manufactures, etc., No. 47, October and November. 1884, Washington, D. C. John Hopkins' University Studies. Herbert Adams' Editor, 3d Series. Maryland's Influence on Land Cessions to the United States, by Herbert Adams, Baltimore, Md., January, 1885, 2d Series. Land Laws of Mining Districts, by Charles H. Shinn, A. B., December, 1884: *Humboldt Library, No. 63.* Progressive Morality. An Essay in Ethics, by Thomas Fowler, M. A., J. Fitzgerald, 20 Lafayette Place, N. Y., 15 cents. Signal Service Notes, No. 15: Danger Lines and River Floods of 1882, by H. A. Hazen, Washington, D. C. Circulars of Information of the Bureau of Education, No. 6, 1884, Washington, D. C. *Humboldt Library, No. 64.* The Distribution of Life, by Alfred R. Wallace and W. T. T. Dyer, 15 cents, J. Fitzgerald & Co., N.Y. The Line of Florida Railway and Navigation Company, Benjamin S. Henning, President, General offices Fernandina, Fla. Illinois Central World's Exposition, compiled by Miss Lydia Strawn. *Journal of Microscopy and Natural Science*, edited by Alfred Allen, January, 1885, Vol. IV, Part 13, 1 Cambridge Place, Bath, England. Proceedings of Boston Society of Natural History, Vol. XXII, Part 4, October, 1883, and December, 1883, Boston, Mass. *The Woman's Magazine*, Esther Housh, Editor, Frank E. Housh, publisher, Brattleboro, Vt., Vol. VIII, No. 5, January, 1885, monthly, 10 cents, $1 per annum.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

APPARATUS FOR LOADING CARS WITH COAL, ETC.—This invention has for its object the provision of improved means whereby box-cars and stock-cars may be readily loaded with coal or the like without the intervention of hand shoveling.

The apparatus consists principally in applying to the delivery or lower end of a coal chute a shunting-apron that is capable of being reversed or swung

around in a horizontal plane for the purpose of guiding the descending current of coal toward either end of the car, as may be desired.

The apron is constructed upon the plan of a quadrant, or quarter-circle, preferably of boiler-plate, and it is connected at or near its radius point to a rod extending laterally from the sides of the chute beneath the bottom thereof.

A hinge-piece is pivotally attached to the under side of the apron by means of a rivet or bolt.

The apron is provided upon its circumference with a raised flange corresponding in height to the chute side. This flange has upon its upper edge an aperture raised portion in order that a supporting chain may not come in contact with the chute sides. The upper end of the chain is attached centrally to a cross-bar of the supporting frame, and its lower extremity carries a hook which may engage any desired link of the chain for the purpose of adjusting the apron in relation to the chute bottom.

When the apron is in proper position the current of coal descending the chute will come in contact with the interposed flange and be thrown toward one end of the car, but when it is desired to fill the opposite end, a fastening bolt which passes through an aperture in the outer corners of the flange and through a corresponding aperture in the sides of the chute, is withdrawn, then the apron is swung around (the hinge sliding upon the rod) to a reverse position.

When the apron is not in use, it may be swung inwardly from either side toward the chute, entirely clear of passing cars.

The above described apparatus has been patented by Mr. A. Chadwick, of Kansas City.

PREHISTORIC STATUES.

An official communication received at the Navy Department announces the discovery on Rapanni, or Easter Island, on the charts in longitude 110° west and latitude 27° south, buried in the depths of the vast wilderness of waters of the South Pacific, of colossal statues and images rudely carved in stone. This remarkable find of archæological remains on a small island hundreds of miles away from any continent puzzles the learned scientists of the Smithsonian Institution and the National museum. Prof. Baird says on the subject: "In the present advanced state of ethnological science these monuments are of the highest importance. They will throw light on the somewhat mysterious manner in which this island receives its population."

The discoveries of these remarkable remains of a prehistoric and an advanced people in part of the world synonomous with cannibalism and savage life were the officers of the German gunboat Hyena, while on a trip from the Valparaiso to the Samoan Islands. The commander of this vessel, while thus cruising in the South Pacific, subsequently received orders from his government to visit Easter Island and secure these specimens. The accounts received by our government indicate

that the vessel remained at the island but a few days, but during that time the German officers made a considerable collection and copious notes. The results of their preliminary labors have been embraced in a pamphlet, which is reported at the Smithsonian Institution to contain a large amount of valuable information. The German government, it is understood, are making preparations to send an expedition to Easter Island with a corps of scientists and engineers to search the island, survey the ground, and to make plans and sections of the prehistoric buildings and ruins.

Our own government has also taken steps to secure some of these valuable remains for its large and valuable ethnological collection representing the prehistoric and known races of this hemisphere. Instructions have already been sent to Admiral Upshur, in command of the South Pacific squadron, to send one of his vessels on a cruise in the direction of Easter Island and to make such explorations, collections and reports as he may think important in the interests of the government. It is understood that the government of France is also turning its attention to this island with a view to the establishment of a protectorate.

It is reported in the accounts by the German vessel that the island, which is small, is strewn with large stone images and sculptured tablets. The Smithsonian has offered $1 each for prehistoric skulls with the lower jaw. The few people of Polynesian extraction who inhabited the island, know nothing about the sculptured remains found, and even tradition gives no account of a people living there when their ancestors arrived.

EDITORIAL NOTES.

PROF. RILEY, United States entomologist, has just received from George Cadell, Esq., Secretary of the International Forestry Exhibition at Edinburgh, the first gold medal awarded to him, it being the only gold medal awarded by the Exhibition managers to an American. The medal is large and handsome, with the words, "International Forestry Exhibition, Edinburgh, 1884." The reverse side has a wreath on a polished face with the words, "Awarded to Professor Riley, Washington, for Collection of Insects Injurious to Forest Trees."

MRS. JULIA SMITH, widow of the late Professor J. Lawrence Smith, of Louisville, Ky, has caused to be prepared for distribution among scientists and friends of the family, a very handsome memorial volume containing an account of his life, the honors conferred upon him in this and foreign countries, and a number of articles upon chemistry and mineralogy, written by him at different periods during his life. Professor Smith was a laborious investigator and an able writer, and the volume is a fitting tribute to his memory from one who knew him best.

WITH the mercury from 10° to 50° below zero in different portions of the country, earthquakes in Spain and elsewhere, avalanches in the Alps, universal snow storms and fierce winds, January, 1885, made a reputation for itself that will not soon be exceeded or forgotten. The 22d especially, was a notably cold day, the thermometer marking from 8° to 52° below zero in all the Northern States, from Kansas to New Hamp-

shire, while the cold was unprecedented in Arkansas, Louisiana, Texas, and other Southern States. Fifteen days steady sleighing in one month is an unusual record for Kansas City, while in the country adjacent it has been good for most of the time for nearly six weeks.

WE call attention of our readers to the article of Professor Bassett upon the Crawfordsville (Indiana) crinoids as containing some facts not ordinarily known. He has been engaged for many years in studying these remarkable fossils under the most favorable circumstances, and for two or three years has made a business of supplying them to museums and public and private collections. Doubtless he is better acquainted with the subject than any man in the West. We have had the pleasure of seeing his best specimens and can testify to their beauty and perfection.

WE are glad to be informed that the differences between the State Board of Health and the Hospital Medical College of this city have been adjusted, and that this institution is now placed upon the same footing as our other medical colleges, so that its graduates will hereafter be entitled to full recognition everywhere.

PROFESSOR S. H. TROWBRIDGE, of Glasgow, Mo., writes thus pleasantly of the REVIEW: "It is and has been from the start a grand success from a literary, educational, and scientific standpoint, and richly merits and should have equal success in a financial sense."

THE time for applications for space in the International Inventors' Exhibition, to be opened in London, in March, has been extended to February 10. The Exhibition will continue for about six months, and will be presided over by the Prince of Wales.

Division 1. (Inventions) will be devoted to apparatus, appliances, processes, and products, invented or brought into use since 1862, and illustrations thereof.

Division 2. (Music) will consist of examples of musical instruments of a date not earlier than the commencement of the present century; and of historic collections of musical instruments and appliances, and paintings, engravings, and drawings representing musical subjects, without any restriction as to date.

MR. EDGAR C. SAUNDERS, of Camp San Saba, Texas, sends us several nodules of sulphuret of iron which, he says, "lie upon a stratified formation of limestone and cover an area about three miles long by three-fourths wide." He notes their resemblance to meteorites and desires to know their origin, whether they have fallen out of the limestone in weathering, or whether they may be really meteorites.

WE learn from Secretary E. E. Richardson's 14th Annual Report of the Kansas City Stock Yards that during the past year the total shipments were: 533,992 cattle, 1,724,287 hogs, 237,214 sheep, 27,092 horses and mules, and that for the fourteen years since the opening of the yards 12,427,422 head of stock have been received and shipped.

THE Leavenworth Academy of Science at its last meeting elected the following officers for 1885: Hon. H. M. Aller, President; Prof. F. A. Fitzpatrick, Vice-President; Dr. R. J. Brown, Secretary, and Dr. T. Sinks, Treasurer. A resolution in favor of a State geological survey was passed and a committee appointed to present the matter to the Legislature this winter.

A committee of the National Academy of Science has replied to inquiries made by the joint committee of Congress on the proposed consolidation of the various scientific bureaus, by presenting a plan for the division of scientific work now performed into four bureaus, as follows: 1. The present coast and geodetic survey to continue. 2. The geological surveys as at present. 3. The meteorological bureau, to which should be

transferred so much of the present personnel and functions of the chief signal office as are not necessary to the military duties of that office 4. A physical observatory to investigate the laws of solar and terrestrial radiation and their application to meteorology, with such other investigation in exact science as the government might assign to it

In this connection they suggest that the standard weights and measures be transferred to this bureau, and that the proposed electrical bureau be also included.

A bill has passed the House authorizing the building of a bridge across the Mississippi at Memphis. It is provided that two of the spans shall be not less than 550 feet in the clear; no span shall be less than 300 feet, and the height of the superstructure shall be 65 feet above extreme high water mark.

It is stated that extraordinary discoveries of silver have been made in the Cohuttah Mountains in Northern Georgia, by a Boston company. They claim to have traced a vein of 1,500 feet extending easterly through the mountain, a distance of eight or nine miles The assays run as high as eighty per cent.

The total enrollment of students at the University of Kansas for 1883-4 was 521, as against 582 for 1882-3. The apparent falling off is explained by the Regents in their report as having been caused by the discontinuance of the lowest preparatory class, which in 1882-3 numbered 125 members. They recommended an appropriation of $50,000 for the erection of a building for the Department of Natural History.

The State Historical Society met in annual session at Topeka, Kansas, January 20. Officers were elected for the ensuing year as follows:

President—D. R. Anthony, Leavenworth.

First Vice-President—B. F. Simpson, Paola.

Second Vice-President—S. N. Wood, Topeka.

Secretary—F. G. Adams, Topeka.

Treasurer—John Francis, Topeka.

The number of directors was increased from forty-eight to ninety-nine, and elected in classes for one, two, and three years.

The retiring president, Mr. F. P. Baker, and M. W. Reynolds delivered addresses.

At the annual meeting of the St. Louis Academy of Science, the following named gentlemen were elected officers for the present year: Prof. F. E. Nipher, President; Dr. Leete, First Vice-President; M. L. Gray, Second Vice-President; Dr. Evers, Corresponding Secretary; Prof. Engler, Recording Secretary; Dr. Sander, Treasurer; Prof. Hambach, Librarian. Mr. Alderdice, Dr. Luedeking and Prof. Hambach were elected Board of Curators.

A company known as the Natural Gas Company has been boring for some weeks at the foot of Third street, in West Kansas City, for gas, and recently struck it in considerable quantity. They claim a pressure of one hundred pounds to the square inch and a capacity of eighty thousand cubic feet per day, and announce their intention of immediately sinking two more wells. If their claims are well founded we may expect to see the manufacturing interests of Kansas City take an immense forward stride at once.

At a meeting of the Anthropological Society of Washington City the following officers were elected for the ensuing year: President, J. W. Powell; Vice-Presidents, Dr. Robert Fletcher, Prof. L. F. Ward, Col. Garrick Mallery, Prof. O. T. Mason; Secretaries, S. V. Proudfit, F. A. Seely; Treasurer, Prof. J. H. Gore; Curator, W. J. Hoffman; Members of Council, H. H. Bates, Dr. Frank Baker, Rev. J. O. Dorsey, W. H. Holmes, David Hutchinson, Prof. Cyrus Thomas.

ITEMS FROM PERIOICALS.

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, *besides, without additional cost, for one year.*

WHETHER we agree with Mr. Beecher or not, few men can speak or write on any subject of public interest with so great a certainty that everybody will want to know what they say. In discussing the question as to how far ministers may properly go in politics—which he does in the *North American Review* for February—the great preacher shows himself to advantage perhaps all the more because it is a matter that touches him personally as well as professionally. In the same number of the *Review*, the question, "How shall the President be Elected?" is ably treated by five happily chosen writers, viz., two United States Senators, Dawes and Vance; a college president, F. A. P. Barnard, of Columbia; a New York lawyer, Roger A. Pryor, and a well-known journalist, William Purcell. The substantial agreement of four of them on the same point is significant. Another notable article in this unusually strong number is a review of "Holmes's Life of Emerson," by the veteran historian, Geo. Bancroft; and still another is an essay by Prof. C. A. Young on "Theories regarding the Sun's Corona," which he skillfully brings within popular comprehension. The Rev. Dr. W. G. T. Shedd defends the dogma "Endless Punishment," and Prof. G. Stanley Hall writes on "New Departures in Education."

WE suppose that we are in debt to Mr. William Hosea Ballou, of New York, for the following flattering notice in the *Saturday Evening Herald* of Chicago: "The KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY is perhaps the only successful monthly west of New York. When literary monthlies find an uncongenial soil in the West, it is all the more remarkable that a high-toned periodical, devoted exclusively to science and requiring seventy 8vo pages for each issue, should grow and thrive. THE REVIEW is almost in its ninth volume. Its contributors are mainly Western men who have conferred a lustre on the unlimited scientific research of the vast prairies and vaster mountain ranges. This successful exponent of class journalism is entirely the work of its able editor, Mr. Theodore S. Case."

WE find in the Boston *Literary World* the following appreciative notice of a new book compiled and arranged by Messrs. Fulton & Trueblood of this city: "The distinctive features of Fulton & Trueblood's volume of selections for readings, 'Choice Readings from Standard and Popular Authors,' are the abundance, variety, and excellence of the selections themselves, the prefixed diagram of the elements of vocal expression, showing the different kinds of thought embodied therein, the representation of the seven great orators of the world, the scenes from popular dramas, and the appended descriptive indices to selections from Shakespeare, the Bible, and Christian hymnology, suitable for public use. The collection is unusually rich, dignified, and suggestive."

WE have received the first number of the *Journal of Mycology*, published at Manhattan, Kas., and edited by Prof. W. A. Kellerman of the Kansas Agricultural College, assisted by J. B. Ellis of Newfield, N. J., and E. M. Everhart, of Westchester, Pa.

It is a neat little magazine of sixteen pages, and will be devoted to mycological botany, special attention being given to the North American fungi. It will aim to be the organ of students of this branch of botanical science, and as such deserves the patronage of all persons interested in it. Monthly, $1 00 per annum.

DURING 1885, subscribers to the *Art Interchange* will receive thirteen (13) full-page colored supplements, some double size; twenty-six (26) extra pattern supplements, containing over one hundred full-size outline artistic designs, ready for tracing, applicable to all the varied branches of art work.

Hundreds of illustrations of other art objects, which are suggestive examples most useful to amateurs and art workers. These can not be procured in any other way. A number of large art supplements, which are reproductions of the most attractive master-pieces. These are printed in the best manner, on fine heavy paper, and are suitable for framing or for portfolio. In all, an actual return of exclusive designs and art material worth two hundred dollars ($200) or more, for $3 per annum.

It is always a pleasure to receive the *Atlantic Monthly*. The February number is especially interesting. We give its contents herewith: A Marsh Island, IV–VII., Sarah Orne Jewett. Winter Birds about Boston, Bradford Torrey. Spirit of Spirit, Edith M. Thomas. Madame Mohl, her Salon and Her Friends; second paper, Kathleen O'Meara. A Sheaf of Sonnets. I Ellen Terry's Beatrice; II The Resolve; III On First Reading Landor's Hellenics; IV Bach's St. Matthew Passion Music; V The Passing of the Year, Helen Gray Cone. The Prophet of the Great Smoky Mountains, II., III, Chas. Egbert Craddock. The Quest for the Gral of Ancient Art, William Shields Liscomb. Vernon Lee, Harriet Waters Preston. A Country Gentleman, IV–VII M. O. W. Oliphant. The New Portfolio, II Oliver Wendell Holmes. Strange, E. R. Sill. Nathaniel Hawthorne and his Wife. Mr. Parkman's Montcalm and Wolfe. Johnson's Persia. A Word for Pepys. The Contributors' Club. Books of the Month.

In the *Popular Science Monthly* for February, which was received rather more promptly than usual, we find the following articles principally written especially for its columns: The Sight and Hearing of Railway Employes, by William Thomson, M. D. (Illustrated); Calculating Machines, by M. Edouard Lucas, (Illustrated); The Larger Import of Scientific Education, by J. W. Powell; Evolution and the Destiny of Man, by W. D. Le Sueur; Food and Feeding, by Grant Allen; Sulphur and its Extraction, by C. G. Warnford Lock, (Illustrated); Physical Training of Girls, by Lucy M. Hall, M. D.; Field Experiments in Agriculture, by Prof. H. P. Armsby; Cholera, I, Its Home and Its Travels, by Dr. Max von Pettenkofer; The Chemistry of Cookery, by W. Mattieu Williams; Sick-Rates and Death-Rates, by Cl. T. Campbell, M. D.; Properties and Constitution of Sea-Water, by M. Antoine de Saporta; Why Birds Sing, by Dr. B. Placzek; Sketch of Sir David Brewster, (With Portrait); Correspondence; Editor's Table: "Mind as a Social Factor"—The Relation of Science to Culture; Literary Notices; Popular Miscellany; Notes.

The Scientific Club of the Kansas Agricultural College meets monthly in the Chemical Laberatory. Professor W. A. Kellerman is President and Professor I. D. Graham Secretary. Among its other active members are Prof. Failyer, Prof. Popenoe, Prof. Shelton, Mr. M. A. Carleton, Mr. Lund, A. W. Jones, J. B. Brown, Warren Knauss, and others. From its proceedings, as published in the *Industrialist*, it is evident that this club is doing a good work for the Institution and the State.

Professor B. Silliman, one of the editors of the *American Journal of Science*, and son of its originator, died Jauuary 4, after a long and useful career as editor, professor of chemistry in Yale College, author of several text books on chemistry and natural philosophy, charter member of the National Academy of Sciences, honorary member of the principal scientific societies of Europe, etc. He was 68 years of age and was apparently still in the prime of life when he was taken away. His loss will be severely felt among scientists all over the world.

Science, now in its third volume, has had a very successful career so far, and has made a decided impression upon the scientific world as an innovator, at least in manuer. It has been ably supported and has presented the new theories and discoveries of the past two years promptly and authoritatively. It is now so firmly established that it can can hardly fail to hold a leading position among the scientific periodicals of the day, either in this country or on the continent. Being, strictly speaking, the only weekly scientific journal in the country, it deserves the patronage of all readers who desire or need to keep fully up with the rapid progress of the age in science.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VIII. MARCH, 1885. NO. 11.

MEDICINE AND HYGIENE.

SANITARY PLUMBING.[1]

JOHN FEE, M. D.

I feel highly honored and gratified with your invitation to address you this evening. It gives me pleasure to meet this Society, composed of gentlemen engaged in the same work, that of practical sanitation, which has occupied my time and labor during the past four years.

I feel gratified with the privilege of meeting you here because I know we can enlighten the people of this city in regard to proper plumbing and house drainage, and place one branch of the art of practical sanitation in such prominence before the public that its untold benefits may be properly understood and appreciated.

We have reached the time in this city when the public must be instructed in regard to one of the most indispensable arts known to man; an art which, more than any other, perhaps, makes the possibility of a great city, and without which mankind would spread out over the country and harmonize with the teachings of Mr. Ruskin.

The intelligent plumber is a practical sanitarian, and his work properly done gives cleanliness, comfort and health. The work of the ignorant and unscrupulous plumber, however, brings expense, discomfort and disease.

1 Delivered before the Master Plumbers' Association of Kansas City, February 10, 1885.

This city is in a transitional stage; it is passing from the town into a city, which if judiciously governed and instructed will, in a short time, become a great metropolis.

To the people of this city then, the study of sanitary regulations has become a necessity. It has been my fortune to investigate, to some extent, the chief great lines of human thought, theology, jurisprudence and science; and during the past four years my study has been exclusively devoted to sanitation, or to the protection of the public health, and I have no hesitation in saying that this latter science is the most essential field for human study and investigation, and offers to society the most practical results and the greatest benefits.

To the student of history there is a great fascination in the study of the moral, social and intellectual development of our ancestors; and no man living amidst railways, telegraphs, and comfortably constructed dwellings can go back to the days of the earliest history of our Indo-Germanic ancestors, when they were but little more than savages, and then trace their development; first, their wrestle with religion; next, their struggle for personal and political liberty, and subsequently their invention of the practical arts and sciences without mingled feelings of pride, wonder and reverence.

In surveying the results of the intellectual development of our race, we must be struck with two facts, namely: The centralization of mankind in great cities, and their increased attachment to this earthly existence. The massing of human beings in great centers seems to be the unavoidable result of our material and social development. These cities are manufactories of all those articles which we consider necessary to our comfort. These are also the centers of thought and of intellectual production and mental commerce, which, in the present brain development of our race are as essential to our happiness as are our material inventions.

The increased attachment of mankind to this earthly home as a result of our modern civilization, is equally apparent. In making this statement, I would not underrate popular faith in a future existence. No doubt this quality of mind is as general now as it has been at any time past in the history of the race, but such are the comforts, material and intellectual, which environ our present existence, that the majority of mankind prefer to bear the pleasures and enjoyments which they have, than to flee to those they know not of. There is nothing strange in this worldly attachment; it would be unaccountable were it otherwise. When we consider the advantages which surround our existence, compared to the meagre pleasures and conveniences of our ancestors, our homes seem like dream-lands, and our material and intellectual advantages like hallucinations or flights of imagination. Let us for a moment survey some of our advantages.

First, we may remark that the invention and use of the sewing machine, electric light, telephone and telegraph are within our own recollection. To some of us this is true in regard to the invention of and use of the railroad, steamboat, nd steamship. The use and application of light within our recollection has olutionized our social organization. For all purposes of business or

pleasure, we have made the night almost as subservient as the day. On the contrary, how gloomy must have been the long winter nights of our ancestors without illuminated streets, and with houses dimly lighted with rude lamps?

Gas for illuminating streets was first used in London in 1816. The candle is a comparatively modern invention. The so-called candles alluded to by the ancients and in the Scriptures, are believed to have been rude lamps for the burning of olive oil, and these were continued down to the end of the eighteenth century. The first improvement in wicks took place in France in 1783.

The use of spectacles did not become general until after 1313, when they were invented by an Italian monk. This universal boon to mankind ought to be considered a very considerable set off against relic worship and asceticism.

Think of one reaching forty-five years of age and then the print of the newspaper growing dim, week by week, until at fifty one is shut off from the news forever. Again, the first weekly newspaper was not printed until 1615, when it was issued in Frankfort-on-the-Main; but the real newspaper, the morning daily, with its fresh news from all parts of the world, is a work that has been perfected and brought into successful operation within the period of our own memories.

But again, nowhere do the advantages of our modern civilization and the disadvantages of our ancestors stand out so conspicuously as in the comparison of habitations. Chimneys were unknown before the fourteenth century, and did not come into general use for a long time afterward. It is even said that the ancients had no knowledge of chimneys. We have only to contemplate our comfortable rooms, heated with stoves or hot air furnaces, or with steam, and then to view our ancestors hovering over a few coals in a dim, smoky room, with no place for the escape of smoke and the poisonous products of combustion, except a hole in the roof, to appreciate our inestimable advantages. Window-glass, also, did not come into use before the fifteenth century. Paving the streets was unknown to our ancestors until 1184, when it was first tried in Paris. It seems to have been an invention which made but little impression on the people, as it was not introduced into London until 1533. Sewers were unknown to our progenitors until the beginning of the thirteenth century and were then only used for the removal of storm-water. Until a comparatively recent period, the discharge of sewage proper into the sewers was prohibited by law in London. The use of sewers for the removal of house waste is an invention of the present century.

But I will not dwell longer on the enumeration of those inventions which are calculated to give a charm and to impart an attachment to this existence unknown to our forefathers.

Although we have elaborated the fact that the tendency of our modern civilization is to the congregating of mankind in great cities, and have pointed out the many gains which we possess over our ancestors, we have yet to mention the additional fact that all these benefits have been obtained by many sacrifices, and that there are innumerable dangers inseparable from our present social organization. These dangers are such as affect the public health. The very flocking

together of human beings into great cities brings numerous diseases, both to infantile and adult life. In fact, these maladies, such as diphtheria, measles, scarlet-fever and small-pox, have threatened at times to destroy great municipalities.

The overheating in the summer season and the ill-ventilation of residences decimate cities of their infantile population. Commerce, too, is a constant menace to mankind, because it brings not only an interchange of products, but also an exchange of diseases.

The ships which come from the Ganges and the Nile to the occident, laden with their rich cargoes, bring with them pestilential cholera; and vessels which sail from tropical ports laden with coffee, sugars, and fruits, bring with them the seeds of tropical fevers; and thus there is a bitter for every sweet, and an enemy skulking in ambush for every friend. It is the mission of sanitary science to give success and permanancy to our modern civilization in every land and in every clime; in a word, to protect the growth and insure the success of great cities. This has been effected for many great cities. The city of London, for example, contains a population equal to that of New York, Paris, and Berlin put together, and yet has a lower death rate than either one of these cities. Sanitary science constitutes a broad and inexhaustible field for human investigation.

It includes a large scope for jurisprudence for law making, international, national, state and municipal. In some countries, sanitary legislation has received a study equal to its importance, and in some parts of the United States, particularly in the State of Massachusetts, it has become an elaborate and useful code, both State and municipal. Practical sanitary science includes the profession of the architect as to heating and ventilation, the sanitary engineer or sewer builder, the plumber, and the chemist, who devotes himself to the study of foods and the prevention of the crime of food adulteration. Here let me digress for a moment and point out the fact that the adulteration of foods is the greatest and besetting crime of the age, and of this country and of this State in particular—that substance only, which is not adulterated, is that article which is cheaper than any adulterant.

Coffee, tea, sugar, molasses, candies, honey, butter, lard, oil, liquors of every description, drugs of every kind, all are adulterated, and no legislature, no State board of health brings the miscreants to justice. Again, sanitary science includes the physician who studies the nature and history of pestilential diseases and their prevention. It includes the labor of the practical health officer, who enforces proper regulations for municipal cleanliness; for sanitary science, when reduced to first principles, to its quintessence, is cleanliness. The architect's endeavor to secure proper ventilation of the home is but an effort at cleanliness. The sewer is an adjunct for cleanliness, and the pipes for house drainage and water-service put in by the plumber are means for reaching the same end.

Sanitary science is the enemy, the antipode, of Malthusianism. It endeavors to prolong life, to save life, to fight off death. It teaches that society has an in-rest in the preservation of every human life, a social, a moneyed, a material t[illegible]he protection and prolongation of every human existence. It assumes

that the child must live for the parent, that the investment of money, love and affection by the parent must be reimbursed and returned by the offspring. It has no fear of the over-production of the human race, and no alarm lest the food supply of mankind will leave them without subsistence. Although I believe that the teachings of Malthus are false and untenable in theory, yet it is a fact that they have been verified in many countries. In many of the capitals of Europe, and in some of the cities of this country, the annual death rate has equaled and in some years more than equaled the birth rate, so that were it not for the constant recruiting of population from the rural districts, the population of these cities would diminish or even become extinct. Some of these cities, however, with the highest and most abnormal death rate, have grown with unparalleled vigor and rapidity, owing exclusively to the influx of population from the country districts.

This destruction of human life in great municipalities, however, has no necessity. It has no compensating advantages to the race; it is not, to any great extent, in obedience to the law of food supply, but is purely the result of human ignorance and indifference to those conditions of health which surround us. It is the result of defective sewerage, ignorant plumbing, ill-ventilation, the over-crowding of tenement houses, and the non-observance of cleanliness, all of which evils characterize all great municipalities. With these general remarks, let us consider particularly the business or profession of the practical plumber.

The plumber is a practical sanitarian and is, perhaps, the oldest worker in the art of protecting the public health. His art reaches far back to the first pages of history. He was known to Jerusalem in the days of the magnificence of Solomon, to Babylon when she was the seat of empire, and to Athens and Rome as they successively triumphed as the controlling powers of the Orient. Wherever the genius of man founded great cities, the homes of wealth and splendor, and the centers of political influence and power, there the cunning of the plumber was invoked to bring pure water from the rivers and lead and control it within the habitations of man, and to give comfort and health to palaces and luxury to the king and his court. In modern times the plumber has figured more conspicuously. His art has been used not alone for bringing limpid streams into palaces for the gratification of courtiers and kings, but it has brought the luxury of pure, wholesome water into the habitations of the poor, into the workshop and manufactory, and has made it subservient to numberless uses unknown to the ancient world, such as for heating purposes and for driving machinery, and thereby relieving man of much drudgery. We are, therefore, principally interested in the plumber of the present day. On this point we may remark, that plumbing is a progressive art, and has undergone many improvements within a comparatively recent period. The practical inquiry then presents itself—what is the state of the art in this city? Has the work performed here been done in the best style of the art? Before answering this question I will say that I have every reason to believe that the gentlemen before me are as well versed in the theory and art of their profession as any equal number of plumbers in any other city of this coun-

try. In answer, however, to my inquiries I think the majority of you will agree with me in saying that the plumbing which has been done in this city has, in the greater part of it, been done in a very unsatisfactory manner. Of course some exceptionally good jobs of plumbing have been made, but as a rule the plumbing work is not up to the latest demands of the art. This is not only true of this city, but it is true of every city where there are no plumbing laws and no inspection of the plumber's work. The condition of plumbing in this city could not possibly be worse than it was a few years ago in Boston, New York, Brooklyn, Washington and Chicago, before their plumbing code came into existence. Let us inquire what are the causes of inferior and dangerous plumbing. First, property owners are largely responsible for cheap plumbing. Many of them have very crude ideas of plumbing and care less to learn anything about it, and know nothing about the dangers of drainage gas. They are eager to drive a smart contract with the plumber, just as they would bargain for the excavation of the foundation by the cubic yard, or for the brick by the thousand, so that they often get cheap plumbing, with typhoid fever and diphtheria thrown in for nothing. The avarice of property owners and their indifference to healthy plumbing is one of the almost insurmountable obstacles to correct plumbing. But again, the indifference and ignorance of some architects as to correct plumbing is another difficulty to be overcome. We have in this city as intelligent a body of architects as can be found elsewhere, but, gentlemen, I impart no secret to you when I tell you that there are architects in this city who cannot write out correct and proper specifications for a complete system of house drainage. Now, we all know that in order to put in a perfect system of house drainage it should be properly provided for by the architect, from foundation to roof, and that if the architect does not do his work properly the plumber cannot perform his.

In this work of correct plumbing the architect has the greatest responsibility, for however avaricious the builder may be, he generally puts great confidence in his architect, and imagines that what the architect does not know is not worth finding out. It is the solemn duty of every architect practicing his art in a great city to make an exhaustive study of plumbing and not to be satisfied with a superficial knowledge of this subject, gleaned from some occasional article found in an architect's journal, or from some specifications of a plumbing contract observed in some book of contract forms, or obtained from the pictures of plumbing fixtures found in some advertising manual which has come gratuitously into his hands from some wholesale manufacturer. It is not enough for the architect to know that the foundation of the house is all right, that the walls will not crack, that the roof will not fall in, that no ordinary wind storm will blow it down, or that no common tramp can raise the window or pick the front door lock ; it is his business to know that he has not written up and perfected plans and specifications for a nest of typhoid fever and diphtheria. But plumbers, gentlemen, have their responsibility in this matter. Have you, as a body, banded together and endeavored to enlighten the community as to the importance of correct

plumbing, and as to the dangers of cheap and imperfect drainage? And have you superintended all your work punctiliously? Have you scrutinized every joint, every gasket, every pipe, as to weight and freedom from imperfect casting? Were there no flaws in the drain pipe, was it properly glazed and laid at a proper inclination? These are questions for you to answer in your moments of self-interrogation. It is only a few weeks since, that a plumber was arrested and punished in New York for carrying through the roof of a house, a phantom or dummy soil pipe. I suspect, notwithstanding the heartless motives unjustly imputed to the plumber, that there are times in his history, when he takes up the morning paper and reads the death notice of some child, that has been removed by diphtheria, in which a feeling of chagrin and remorse steals over him. But again, the city government, the health department, and the sanitary superintendent are responsible for this lack of correct plumbing; for it is a fact, that good plumbing is not general in any city unless regulated and obtained by law.

As long as street cleaning or the removing of garbage is not regulated by law, so long will the city be filthy. So long as every man is let to adulterate food, so long will the common necessities of life be debased by heartless men, and so long as the building of a system of house drainage, in any building, public or private, is left to the avarice or ignorance of any man, so long will that art jeopardize the safety and welfare of the community. As before remarked, I suppose that some of the plumbing work in this city has been faultless, both in theory and construction, but it has not fallen to my lot to see any of this work. I have, however, been credibly informed of its construction. I have, on the contrary, seen numerous instances of incorrect plumbing. I have seen soil pipes without fresh air inlets, and terminating on the same floor as the fixtures, or on the first or second floor, without going up through the roof. I have seen a soil pipe in a residence end in the chimney. I have known it to terminate in the smoke-stack of a public building, either to be filled up with soot or, under some circumstances, to be so affected by the draft as to unseal the traps. As a rule, I believe that the danger of the siphonage of traps has been wholly overlooked and ignored in this city. I have never seen a common "S," or siphon trap, ventilated in this city, yet I know that there is not a city, where there is a plumbing law, that would allow an "S" trap without a vent pipe to be connected with any fixture of a soil pipe.

Now, gentlemen, I think you will agree with me when I say that we need a reformation in the plumbing work of this city. That reformation should begin first with the work of putting in the water service. There is nothing so essential to the public health and comfort as the general use of the water service. We need in this city to get our water supply from above Argentine, or preferably above Wyandotte, and then we shall abandon all cisterns and wells. In fact, no well should now be allowed by law within the city limits. Water then should be introduced from the public supply into every tenement and lodging house and into every habitation in the city. But the water service pipe must be put in differently from the work done heretofore. This freezing of the water pipe or shut-

ting off water from the household during two months every winter must be stopped. It is the business of the plumber to put in the pipe so that it will not freeze, to jacket it with resin or plaster-of-Paris, or with some other non-conducting material, so that it will not freeze up. There is nothing that brings your art into such disrepute as the yearly freezing of the water service pipe, and the little money you make by repairs of frozen pipes is more than ten-fold counter-balanced by the fears and prejudices of house-holders against plumbing on account of this annual bursting of pipes and the expenses and damage incurred thereby. No plumber should ever put in any water pipes which he knows will freeze up, without a decided and vigorous protest. With regard to drainage pipes all should demand that the work and material be equal to the most advanced knowledge of this service. To affect this purpose the work will have to be inspected by a practical plumber acting under municipal authority, and municipal authority will have to be secured through the members of the city council. Here you may meet with difficulty, but perhaps not with as much as you may expect. I believe that Kansas City to-day is ahead and in the lead of all the cities of the State in sanitary matters and that the public sentiment here is more progressive than elsewhere within the State.

The greatest drawback in this city is want of money. We need money for a city hall, for a hospital, some people think for a market house, and for grading and sewering the city, so that our legislators are apt to think we have none to spare to pay more city officials. It seems to me, however, that the inspection of plumbing is too important a matter to be delayed on account of the demands on the treasury, and that the expenditures of the city, in other directions, should be so curtailed as to leave a fund for the inspection of plumbing. Within the last ten days numerous complaints have been made to me of sickness induced by drainage or soil-pipe gas. I have been so busy that I could not inspect the localities reported, but I fear that on inspection the complaints will be found to be true.

Again, if the inspection of plumbing is delayed for a number of years it will be a very difficult matter to remedy defects, and property owners will be indignant at the great amount of work to be torn out of their buildings. In a matter of such vital interest to the public health, the expense of a plumbing inspector ought not to form any valid objection, and I believe will not when the facts are properly presented to the city council in regard to the legislation which you require. I hope, gentlemen, that before another year your influence will be felt throughout the country. Other associations within the same time have achieved a national influence and reputation. The master plumbers of Chicago, for example, illustrate the truth of my statement, as shown by the following extract from a lecture recently delivered at Hershy Hall by Dr. O. C. DeWolf, health commissioner of that city. The doctor says:

"One year since you did me the honor to invite me to address you on such t as would mutually interest us as sanitarians, and, on that occasion, I he first time, a body of artisans of whom I had known much and seen

little. I ventured to suggest to you the importance of intelligent organization, and pointed out to you some of the results to your guild which might be expected to follow such united and harmonious action. I am surprised at the work you have accomplished. I have seen the president, recording secretary, financial secretary and a majority of the executive committee of the National Association taken from your ranks, and to-night you stand among your fellow craftsmen the most influential body of plumbers in the United States. This statement will not be denied by any one who has followed the professional literature of your guild for the past few months. I congratulate you and rejoice with you. As a preface to what I have to say to you to-night, I wish again to emphasize the importance to yourselves of a wise, broad, intelligent, active and generous spirit of association, both for personal benefit and that the influence of your organization may be as far-reaching and potential as you desire."

Here, gentlemen, I should, perhaps, stop, but I cannot refrain from making some suggestions to you in regard to your avocation and its relation to your pecuniary, social, intellectual and political influence. Your vocation is a peculiar one. It is not a business which simply requires labor, even skilled labor, but it is both an art and a science. The man who can wipe a joint perfectly, who knows the mechanism of a flush-tank, or of a system of house drainage or of steam fittings, is not, therefore, a perfect plumber. He must not stop with the mechanism of the business, but he ought to know much of its theory and of the chemistry and science of the materials with which he labors. The plumber ought then to be more than a laborer; he should be a skilled and scientific artisan. I take it for granted that the object of your association is personal improvement, intellectual, social and pecuniary. What then will contribute to your success? I answer, to raise the standard of intelligence, of professional skill and social worth high in your association. Make the admission into your guild as difficult and not as easy as possible. Lengthen out the period of apprenticeship. I do not know how long it is, but it should in my opinion be not less than five years. In addition to this, you should require of your apprentices a regular course of study and annual examinations, which could be made before a board of examiners appointed from your association. To my mind, a programme of examinations like the following might be adopted: At the end of the first year, examination in arithmetic and book-keeping; second year, algebra and elements of drawing; third year, algebra continued and mechanical drawing; fourth year, elementary chemistry and hydraulics; fifth year, hydraulics continued and the special chemistry of water and of the metals. These studies could be pursued during the long winter evenings and would take the young apprentice away from the evil allurements of city life and would force him to spend his otherwise leisure hours in a school for mathematical instruction and in the laboratory of the practical chemist, and would cause him to become a thoughtful, well-rounded man, and an influential citizen.

Nothing lowers and debases a business or avocation so quickly and surely as easy and cheap access to it. All the evils of low wages, scamped or inferior

workmanship, of unfair and dishonorable competition, of jealousies and of professional envy and backbiting, can be traced directly to short and hurried apprenticeship. A business or profession which shortens its course of study of apprenticeships, which eagerly seeks every youth for its pupil, and opens wide its portals of instruction, offering every inducement which appeals to indigence, ignorance and to mental inactivity and stupidity, is not worth having, and is alike disgraceful and dishonorable to the recipient and to the donor. Again, gentlemen, I say, make your standard high, access to your ranks difficult, the period of apprenticeship and of instruction long and exacting, and do not fall in with the popular idea of license instead of liberty, which accords to any man the right to follow any profession or carry on any business, however intimately or delicately associated with the public welfare, without a previous training and instruction for intelligently and skillfully discharging its obligations. Permit me to say, in conclusion, that for reasons which are now manifest, I ought not, perhaps, have acceded to your invitation to address you. My official duties during the past four years have been so numerous and exacting that I have had no time for literary composition and for preparing a lecture, such as would do justice to you or myself. But I could not resist the opportunity of co-operating with you in your first efforts in this city. And, gentlemen, whatever shall be my future in this city, in office or out, you may always consider me at your side, battling with you for your rights as sanitarians and as public benefactors.

GEOLOGY.

DESCRIPTION OF MARBLE CAVE, MISSOURI.

FURNISHED BY CAPT. J. B. EMERY.

Roark Mountain, in Stone county, Missouri, is the highest point of the Ozark range within a radius of twenty-five miles. It is surrounded by the head waters of Roark Creek, Big and Little Indian Creeks, Fall Creek, and Jacob's Branch, all flowing in different directions. To the south is White River, towards which the mountain slopes; to the north James River. The first is about three, the other six miles from the top of the mountain.

That top is a strip of table land, about one mile long and from an eighth to a quarter of a mile in width; one thousand feet above the level of White River. A magnificent view presents itself from that point. The eye sweeps over range after range of mountains, heavily timbered with oak, black-walnut, cedar and pine, valleys with streams meandering through them. A bracing, invigorating here. Abundance of game. Springs of pure water, and medicinal springs,

chalybeate, sulphur, etc. Almost every variety of ordinary fruit finds the soil and climate congenial.

Nearly in the middle of the level space on the top of Roark Mountain is a depression, an oval shaped sink, two hundred and fifty feet long and eighty feet at its greatest width. This sink is the mouth of a funnel, standing perpendicular above the mouth of a gigantic cave, called Marble Cave, after the rock by which it is walled in. The mouth of the cave is in the middle of its roof.

The sides of the funnel taper downward, rather steeply, till a depth of one hundred feet is reached. Not so steeply, however, but that one can climb down them along a rugged path. These sides are of huge blocks of flint-rock with earth between, sufficient to afford, at intervals, footing for trees one foot and a half in diameter.

After having gone down the side of the funnel-shaped sink, one comes to another opening nearly oval, thirty feet long and from five to fifteen feet in width, the bottom of the funnel. This opening is at two places bridged over by large rocks, which have fallen down and become wedged in. It really is a hole in the top of the roof of the cave, which roof here is from fifteen to twenty-five feet thick. Now the rock is grey marble. Below one of the wedged-in rocks, a ledge projects, jotting out from the side of the hole in the roof of the cave. A path leads to that ledge. From the ledge one descends by means of a ladder, sixty-five feet long, to the top of a pile of rock, earth and rubbish, rising upward in the shape of an irregular truncated cone, from about the middle of the floor of the cave. That pile is about two hundred feet high. A rough, winding path along its side leads to the floor of the cave.

The cave is nearly circular, in the shape of an inverted bowl, flattened at the top. That flat top is of dove-colored marble and two hundred feet in diameter. The floor of the cave is seven hundred feet in diameter. The roof is about two hundred and fifty feet high. The sides along the bottom are of granite. Above that comes a layer of onyx, mostly white and sixty feet thick; above that thick layers of dove-colored, variegated, brown, red and drab marble, mostly dove-colored; and between the layers of marble are thin layers of flint rock. Between the layers of marble in the sides and the flat marble top of the roof is limestone.

The base of the cone-shaped pile in the cave is from two hundred to four hundred feet in diameter. It comes at one place within a short distance from the wall of the cave and at another leaves a space of nearly five hundred feet. It seems to have been caused by a volcanic upheaval and increased by earth and debris falling down through the opening above. At noon the vertical rays of the sun strike the top, rendering the strata in the roof dimly visible, and more clearly outlining the upper part of the cone-shaped pile. For the rest, the cave is dark.

Countless bats have for centuries been swarming in the cave and through the passages and rooms connected therewith, whenever the weather is cool. The floor of the cave is covered by a layer of guano, the deposit of those bats, and by myriads of carcasses of such as died and decayed long since; which last is evidenced by numerous small bones found mixed in. That layer of guano has

thirty feet long and forty feet high. This room, during cool weather, is so filled with bats that they completely cover and hide the wall all around, giving it the appearance of black velvet. Whenever disturbed they fly about in such numbers as to put out any light not protected by a lantern, and incessantly flap against one's face. Hence the room is called The Battery. A very thick layer of guano covers the floor. At the further end is a small stream of water, about three inches deep and three feet wide, all saturated with guano, and running onward between rocks. A boy, Dick Powell, son of a member of the cave company, followed the stream for a distance of 100 feet and then, coming to a precipice, turned back. Through the passage from the Battery to the Mother Hubbard Room, a strong inward current of air constantly forces itself. Therefore this passage has been designated as the Inward Wind Passage.

2. A second passage, about three and a half feet high and the same in width, is called the Outward Wind Passage, by reason of a current of air rushing from the cave with such force as to extinguish any light not in a lantern. It has been explored only about 150 feet, at which point progress is stopped by cross stratum of onyx, dividing the passage and rendering it too narrow. A large fire of pine knots once was kindled in it, and the draft carried the smoke off without hindrance. Probably it leads to an opening in the side of the mountain.

3. A third passage, slanting with an incline of 45°, and circular like a hole, three and a half feet in diameter, leads to a room about thirty feet long, ten feet wide and fifteen feet high. This room is called Powell's Room, after T. S. Powell, vice-president of the company, who discovered it. A short straight passage, also a creepway, leads from this to a similar room, in size half of the former. Another creepway connects this second room with a third still smaller, in size about one-third of the first. The floors of these three rooms are vast deposits of guano, depth unknown. A fourth passage leads farther on but has not been explored, because it has been greatly stopped up with guano. The walls of these three rooms are smooth blocks of white onyx and dove-colored and red marble piled up.

4. A fourth passage, in size similar to the former, runs down at an angle of 45°, to an almost circular room about fifteen feet in diameter and ten feet high. This room seems to have been a den of bears, as the ground, also a guano bottom, is strewn with bones of bears. Waste water, from the spring in the cave, runs through this room and into a farther room, visible but not accessible along the stream. The guano is partly spoilt by the water. Rock, marble and onyx.

5. A fifth passage, the most tortuous of all, circular in shape, about 190 feet long, and at some points only two and a half feet high, leads to a room of serpentine shape, not over three and a half feet in height. The floor of this room is brilliant red clay, very strongly impregnated with saltpetre. Here neither bat nor guano is found. But the room, the length and width of which has not been accurately ascertained, is filled with mummified animals. There are bears, panthers, otters, racoons, opossums, wolves, foxes, lynxes, etc., and one specimen of what seems to be an antediluvian animal of the genus pterodactylus. Also

smaller animals, seemingly some kind of monkey. These mummies are in an attitude of repose, as if the animals had come here to die. Hence the room is called the Cemetery. Hair on the dried up skins is well preserved. The roof of the room is marble. The sides, so far as seen, are a glistening quartz, believed to be silicate of zinc, but not yet analyzed. What may be beyond this room has not been ascertained.

6. A sixth passage is located at the rear of the spring. It is about two feet wide and forty feet in height, and tapers toward the top. It really is a crack, about thirty feet long, in the rock, level and straight. Red, white and brown stalactites hang down from the roof. They reach so low that one has to creep under them. It ends in a circular room, about twenty feet in diameter. The roof, about fifty feet high, is conical. Water constantly falls from points all over the ceiling, as if that were a colander or sieve. This creates a perfect shower. The water escapes through interstices between blocks and fragments of rocks which constitute the floor. The sides of the room are enveloped in water-formations, and the sides of the roof are covered with bright, brown stalactites. An immense stalactite hangs from the center. The room is called the Shower-Bath Room. The space below has not been examined. Neither has it been ascertained where the water goes to.

7. A seventh passage has a round opening three feet in diameter, and retains that shape. It winds and at first is level, but soon begins to slope. The ground is strewn with small bones and teeth. It seems to lead to the space whither flows the water from the last described room, but as yet it has been explored for only a distance of 100 feet.

8. An eighth passage is about six feet wide at the opening and three and a half feet high. It gradually increases in height until, at a distance of forty feet from the beginning, it is six feet high. Up to that point it is level; but now it descends and widens, the roof remaining level, until at a distance of 140 feet from the beginning, it is twelve feet wide and forty feet high. The ground is granite and red clay. The passage ends in a room called the Blow Room, after the late Hon. Henry T. Blow, of St. Louis, who in 1869 penetrated thus far and chiseled his name in the wall. The Blow Room is about 100 feet wide, 250 feet long and 100 feet high. The floor, also of granite and red clay, is level in the center but slopes both ways. On one side is a hole forty feet wide, opening upon a precipice 130 feet deep. At the opposite side is a round shaft, six feet across, partly covered by a great slab of rock. This shaft is thirty-two feet deep. It ends in the roof of a nearly level passage, about ten feet high and six feet wide. After having followed this passage in one direction for forty to fifty rods, one crosses a stream of clear water, about ten feet wide and one foot deep. The passage then widens and becomes the cañon of the stream, which one has to cross and recross. Occasionally it gets lower, so that one has to creep. From time to time it expands into rooms, none over twenty feet high, twenty feet wide and varying in length from thirty to fifty feet. This passage has been followed for a distance of two miles, and upwards of twenty rooms have been passed. It is

tortuous, monotonous, has no water formations on walls or roof, descends with the rapid current of the stream, and has in some places a rough, and in others, a slippery floor. The rock is granite of beautiful colors and of a high degree of fineness. The emery rock already mentioned also shows itself in some places. The passage might be followed farther; but has not been yet from lack of time. Bats are still occasionally found. Some guano, but not in beds; probably the water has mostly carried it off. Following from the bottom of the shaft the same passage in an opposite direction, one descends more than when moving the other way. It winds round, and while it continues (about which more anon) soon therefrom branches off another passage. This traverses four rooms in succession, and ends by reaching the bottom of the precipice, first seen from the great gap in the wall of the Blow Room. The four rooms average about twenty feet in height, and vary in width from ten to twenty-five feet and in length from thirty to sixty feet. Three have projecting ledges running all around along the sides, interrupted only by the openings of the passage. One can walk over those ledges as in a gallery. The floors slant and are, as well as the walls and roof, of granite and yellow and variegated marble. Very little guano. Here and there are holes in the floor, showing underneath similar rooms of less height. In these lower rooms are several small, swift streams of very clear water, running in different directions.

The room constituting the precipice is 230 feet high, nearly circular, and seventy-five feet in diameter. It is called the Voice Room, because frequently sounds are heard there, so strikingly resembling human voices that an explorer, on first entering it drew a revolver in self-defense. Probably they are echoes of falling water, and depend on the rush. The lower part of the Voice Room is emery rock, the upper part granite, between which two the top of the precipice, or level of the Blow Room, is about the dividing line. Opposite the passage through which one has entered, is a kite-shaped crack in the wall. This crack runs up about twenty feet. Near the top it is about twenty feet wide, and at the bottom the sides close together in a point. It is the entrance of an almost straight passage which retains that shape, and first descends, at an angle of 45°, but later becomes a little less steep. The crack grows larger at the top and higher, till it reaches sixty-five feet in height and, near the top, forty feet in width; but at the bottom it always remains, coming to a point. Here and there in that bottom are holes affording a view of rooms below, to a depth of about thirty feet. It is all emery rock; no other rock is any longer met with. It leads into what is called the Waterfall Room. This room is crescent-shaped, and about 100 feet high. One enters it at one of the corners of the crescent. From there to the opposite corner is about 200 feet. About the center it is thirty feet feet wide. Near this center, about the middle of the outer line of the crescent, is a recess in the shape of a horse-shoe. The two points of the horse shoe are fifty feet apart, and the curved line between 125 feet. The wall of this recess is perpendicular and sixty feet high. Down it falls, with great force, a large body of water coming from rooms above. One can pass behind the fall; between it and the wall. The spray is such as to extinguish, anywhere in front, a light not

protected by a lantern. The entire floor of the Waterfall Room is covered with beautiful water formations, resembling the figures on a carpet, but standing out in relief. The walls are similarly covered, the formations looking like pails, baskets, etc. In front of the fall are jug-shaped basins, varying in depth from one to two and a half feet, and in width from six inches to three feet, with openings only big enough for the insertion of the hand. The water streams in them, and probably passes out again through small cracks; which matter, however, has not yet been ascertained, nor what becomes of the water. These basins contain white, soft, blind, toothless lizards, from two to six inches in length. The roar of the waterfall, and of other falls below not yet reached, is such as to render conversation in any portion of the room impracticable.

At the opposite corner of the crescent is an ascending passage about four feet wide. The roof of this passage is a continuation of that of the Waterfall Room. The floor is of red clay, very slippery, into which steps must be cut, as the angle is 45°. The passage is nearly straight and about 100 feet long. It ends in a room sixty feet above the level of the floor of the Waterfall Room. This room, which one enters by a turn to the left, is about ten feet high. It contains one large spring and a cluster of smaller ones. In a backward direction it is connected by a passage about forty feet long and four in height and width, with a similar room, also containing springs. This second room is, by a similar passage, about twenty feet long, connected with a third room of the same kind. The two first rooms are about of a size, but the third is smaller. The third room contains the head of the waterfall; and the springs in the rooms last mentioned furnish a portion of the water. These rooms and the connecting passages are together between 300 and 400 feet long. The rooms are about thirty-five feet in width. From the first and second rooms, passages lead to other rooms beyond, but these have not been explored. Water also flows from those unknown farther rooms. The waterfall is fed, not only by the springs above described, but also by a swift, shallow stream, about thirty feet wide, coming through a low cañon. This cañon has been ascended for a distance of about 700 feet, and might be farther explored. The entrances to ten passages, all but one ascending, and with water running through them, were passed. Half of these passages are on one side, and the balance on the other, of the cañon, at very irregular intervals. They have not been examined, except the second to the left, which descends and is dry. That passage is about eight feet wide and four feet in height. Its entrance is dammed by rock and water formations. The passage gradually increases in height, until it reaches ten feet. It winds and is about 200 feet long. It opens on a semicircular room. The descent to that room is very slight. The room is over sixty feet high; greatest width twenty feet; length of outer curve feet. The walls are emery rock and red clay; preponderance of red clay. it one half of the floor is covered with a thick layer of fine guano. The uncov- balance shows the red clay. The entrance is at one end. At the opposite the wall does not go clear to the top, but runs up to a height of thirty feet. t of red clay, studded all over with pointed pieces of mica, of

about the length of a finger, glittering like diamonds and soft enough for chewing. About the middle of the outer curve, thirty feet above the floor, in the outer circular side, is a hole, about six feet in height and four feet in width, the entrance of a passage about twenty feet in length, which ends at a precipice of unexplored size. Rocks thrown down that precipice are heard to strike the bottom in the time required to count twenty-one.

Near the clay wall is a winding and gently descending passage, about four feet wide and from five to ten feet high. It leads in succession to three rooms, which average twenty feet in height and twelve feet in width, and are semi-circular, and with arched roofs. In length they vary from thirty to fifty feet. Some guano, but no great quantity. Passage and rooms together about 500 feet long with emery rock and red clay. This passage, always descending, ends in the one which passes the foot of Blow Room shaft. The point of junction is 200 feet from the bottom of the shaft. Between these two points is the entrance of the passage taken when going toward the Voice Room, so that a circuit has been made. The passage in the roof of which the shaft ends, continues beyond the point of junction just described, but has not been farther explored.

This entire part of the inside of Roark Mountain, is one vast labyrinth of caves and passages, the one above the other and as yet only partly known.

9. A ninth passage has its entrance fifteen feet above the bottom of the cave. That opening is wedge-shaped; the base is three feet, and the sides come together at a height of ten feet. The passage retains that shape. It is level and smooth at the bottom, but the sides are rough and only a small sized person can enter. This passage is sixty feet long. It leads to and ends in a small triangular room. The floor of the room is an isosceles triangle, each side twenty feet. The roof is pyramidal and about fifty feet high. From the top, stalactites, clear as crystal, from one to five feet long, hang down. The sides are covered with crystals of translucent onyx. On the bottom is but little guano, as the bats seem to prefer smoother roofs and larger rooms. Water formations so completely encrust the walls that the nature of the rock has not been ascertained.

10. A tenth passage is a crack in the wall of the cave, near the point where the foot of the cone-shaped pile comes closest to that wall. The crack is wedge-shaped and seventy feet high and three feet wide at the bottom, the sides coming together at the top. The passage thus made is rough from protruding flints, and descends at an angle of 45°, until, at a distance of sixty feet from the starting point, it is intersected by a precipice forty-six feet deep. Across the precipice, leaving a gap of about six feet, is a projecting ledge about two feet thick. The passage continues across this ledge, but becomes much narrower and has not been further examined. Descending the precipice with a ladder, one finds an oblong room about fifteen feet wide and twenty feet long. The top is on a line with that of the passage, except in so far as the projecting ledge mentioned intervenes. The bottom is very thickly covered with guano. Sides perfectly plumb and as smooth as masonry, of dove-colored marble. In the wall under the ledge is a hole about five feet high and three feet wide, through rock

two feet thick. This hole gives access to another similar room, the floor of which is on a level twenty feet lower. That room too, is oblong. It is fifteen feet wide twenty feet long and twenty-five feet high. Walls like those last described. In both these rooms the layer of guano which covers the floor is at least ten feet thick, as with a pole of that length, bottom could not be reached. The first of the rooms is called the Jones Room, after Dr. T. Hodge Jones, secretary of the cave company, who was the first to explore it. The second the Arnold Room, after F. D. W. Arnold, treasurer of the same company; for a similar reason.

11—15. Where the foot of the cone approaches closest to the wall of the cave is a recess in that wall. Five passages, all low and narrow, lead from that recess. They are about three feet high and three to four feet wide, and slope gently downwards. Each leads to a series of small rooms of irregular shape. Only nine of these rooms have been visited. Passages and rooms both have been but imperfectly explored. The rock in them, and even in the recess of the cave, is of an alkaline nature and crumbling. Everywhere are loose stones and debris. The rock easily slackens and pulverizes. An acid causes it when pulverized to effervesce. The application of water hardens it into the likeness of plaster-of-Paris. The color is light gray. It has not been analyzed. No guano here. The bats avoid this place; probably because the rocks in the roof are apt to tumble down. This same circumstance has retarded more thorough exploration.

The temperature of the cave is 56° F. during the hottest season. It rises slightly in rooms and passages below. Whenever the weather is cool, a person sitting on the top of the cone at the foot of the ladder, can see myriads of bats sweeping down the mouth of the cave.

The "Wilderness Road," a wagon-road leading from Springfield, Mo., into Arkansas, passes within four miles of the cave. These four miles can be traveled over by a remarkably good natural road, with beautiful scenery all the way. Springfield is forty miles from the point where this road strikes the Wilderness Road.

Forsythe, the head of navigation on White River, during the high water of spring, is fifteen miles in a straight line from the cave. It is the county seat of Taney County. Galena, the county seat of Stone County, is also fifteen miles off, and Ruth, distant six miles, in the same county, is the nearest postoffice.

Capt. Emery, in a private letter, says that while the above description may be in some points slightly overdrawn, it is in the main very correct, and that "not half of the wonders of the cave are told."—[Ed. Review.

A NATURAL CURIOSITY.

About two miles south-east of Santa Paula and near the foot of the mountains is a natural curiosity. The rocks, which were once doubtless impregnated with petroleum, have undergone oxidization, all the bituminous matter having been burned out. They consist of horizontal strata of sandstone, some coarse and others fine grained. The oxidization bears evidence of having taken place ages since and to have extended to a great depth. As a result of these internal fires, a circular district, some five or six hundred yards in diameter, has sunk to the depth of about one hundred feet, leaving an opening on the west side. A conical hill rises in the centre to the height of nearly one hundred feet, capped with sandstone. The perpendicular walls extend nearly around the depression, showing a fine exposure of stratified rocks of various colors. Those containing most bituminous matter are left more highly colored and present a pleasing contrast to the gray layers that were less affected by the heat. About a half mile from this amphitheater and a thousand feet higher up the mountain is a solfatara similar to what this one was at the time, and from which hot air and steam are still escaping. Mr. George Richardson, who owns the land upon which the solfataras are situated, informs us that the living one was much more active sixteen years ago when he first came to this place. The places described are well worth visiting.—*Ventura Free Press.*

ENGINEERING.

THE NICARAGUAN CANAL.

ADMIRAL DANIEL AMMEN.

While there are other considerations which might determine our government to execute a great work such as the Nicaragua Canal at even a commercial loss, it is obvious that a limit exists beyond which action should not be taken; such for example, I would say, as the sea-level canal at Panama, involving primarily from its physical conditions enormous outlays, entailing great uncertainty of results, and certainly great outlay for its maintenance in a navigable condition, and from time to time serious delays from land slides into the canal. The subject presents itself as abnormal, distasteful, and unnatural if not considered commercially. What will the canal cost, and what for its maintenance? What will be the minimum traffic, and what period of time will be necessary to execute the work?

On the present location the engineer's estimate for labor and material is

$41,193,839. In every construction of this kind what is known as a contingent fund is requisite for machinery, superintendence, unforeseen difficulties, delays, interest on money, etc. More recent examinations assure the fact that the canal location can be very materially improved, but as this has not yet been effected instrumentally, no reduced estimate for labor and material is admissible, and, although considerable will result, it will not be taken now into account. Over the present line of location the cubes are well ascertained, and the character of the material to be excavated is approximately known. The estimate for dredging where the material can be flumed into its place of deposit is thirty-five cents per cubic yard. Improved machines make this estimate excessive, and there will be not less than fifteen miles of dredging of the fifty-three miles requiring excavation, if further location does not reduce this ten miles or more, which is highly probable. On the eastern section 24,064,053 cubic yards in earth is given at thirty-five cents per yard. More than half of this can be dredged and flumed to its dumping ground at a cost not exceeding one-third of the estimate. Rock excavation in the San Juan River is given at $5.00 per cubic yard, when it can be contracted for at a considerably less figure. The reader will bear in mind that all of the engineer's estimates were doubled by the canal commissioners appointed by the President, and will also be here in stating the maximum cost of the canal at $82,387,678.

The engineer's estimate for earth was thirty-five cents; for stiff clay, forty cents, and for rock "in the dry," $1.25 to $1.50 per cubic yard. The dumping grounds throughout are very convenient, as they may well be on a lock canal, and there are no cuts of more than forty-five feet in depth above the water level, and they are quite short. The mean cut above the intended water level of the canal is less than ten feet, and the deepest fills are three feet below it. As all of the excavations can be made with sufficient natural drainage, except the parts that can be dredged, the most economic conditions exist for the execution of every part of the work, and this would not be the case were it a sea-level canal, where blasting and removing rock must be a slow and expensive operation.

The engineer's estimates were not made to favor the construction of the work; they were made for the government. With a contingent of twenty-five per cent, which perhaps would prove too small, it is not at all improbable that the cost of the canal, when executed in the best manner, may not exceed $65,000,000, interest included. Without sacrificing economy nearly every part of the construction can be entered upon at the same time, and for this reason the canal may be open for traffic within five years from this date.

Admitting the maximum figure for construction instead of the last named, let us consider a minimum figure of tonnage and of transit dues. Of immense importance to us prospectively is our coasting trade which would pass through it. One million tons for the present would be a low estimate, and in less than half a century it would be five times that amount. The grain product for export to Europe of the north Pacific Coast now exceeds 2,000,000 tons, and the vessels partly laden with iron and coal and partly in ballast, going through the canal for

cargo, would be not less than 1,000,000 tons. Then we have the traffic to and from Japan, northern China, the Phillipine and Sandwich Islands, the islands of the south Pacific, New Zealand, and Australia, to and from our Atlantic Coast and European ports. One million tons would be a small estimate. We have then 5,000,000 tons plainly in sight as soon as the canal is open for traffic, and will leave the traffic of the west coast of South America to the Panama Canal; upon the hypothesis that it will actually be completed. With canal dues of $1.00 per net ton and deducting $1,000,000 for maintenance of the canal and for towage, we have $4,000,000 for dividends, which is a small fraction below five per cent on $82,378,678, the maximum cost of the canal arrived at by doubling the engineer's estimates.

But a traffic of enormous proportions will develop from the construction of the canal, without which it would be impossible; the timber traffic from Puget Sound extending northward even to Behring's Strait, to our eastern coast, and to Europe. In order to have a conception of what this will amount to, let the skeptic visit the Liverpool steamer Oregon and examine the thirteen splendid timbers in bright colors from the State of Oregon, with which that vessel is finished. The yellow cedar when finished is as beautiful as satin, is as easy to work as cypress, and surpasses oak in durability. All of these timbers are superb and are to be found in enormous quantities convenient for shipment, and can be put on board of sailing vessels and auxiliary propellers at small cost and with munificent profits, and can be sold in Europe at certainly below the market price, at this time, of ordinary pine plank; add to this the constantly increasing wine product of California, and we see at once what a mine of wealth the construction of the Nicaragua Canal will bring to all of the inhabitants of the west coast, and what an amelioration it will prove to those of our east coast and to Europe.

We may well conceive that the earnest commencement of the construction of the canal would serve at once to establish our ship-building interests and our iron trade, upon which almost all the prosperity of our industries depends, and thus revive the entire traffic of our country. We see in this timber traffic that the canal dues will soon have to be reduced to fifty cents per ton to avoid a revenue far above the usual rate of interest paid on an investment.

Such persons as may object to a government construction of the work are reminded that our citizens holding a concession were unable during a period of years to obtain of Congress a simple act of incorporation. It is idle now to inquire into the influences that prevented; the question now is presented in its simplest form.

Statesmen may perceive the advantage of our Government constructing the canal rather than abandoning it to another government. They may perceive, too, that after developing the commercial certainty of this canal the nonconstruction of it by us will not prevent its construction by others. Were it only for the purpose of silencing the question politically, it would seem cheap to construct it were the cost ten times the amount of the sum named. It would prove a far

better economy than spending double that amount in war, which would seem altogether a probable result from non-action at this time. If we do not now determine on the construction of the canal ourselves, we certainly would have small reason for complaint were Nicaragua to grant a similar concession to any other power to that agreed upon with our Government.—*National Republican.*

METEOROLOGY.

METEQROLOGY OF THE MOUNTAINS AND PLAINS OF NORTH AMERICA.

CAPTAIN SILAS BENT.

We extract the following from an address delivered at St. Louis, Mo., November 18, 1884, before the Cattle-Growers' Convention, upon the subject "Meteorology of the Mountains and Plains of North America, as Affecting the Cattle-Growing Interests of the United States." Captain Bent has given the subject of meteorology deep study, and his views carry weight with all western people, at least.—[ED. REVIEW.

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These plains extend from Texas to Canada, about twelve hundred miles in length and with a width eastwardly from the base of the Rocky Mountains of about three hundred miles, making an area of 360,000 square miles, or upwards of 250,000,000 acres of land which, with rare and limited exceptions, are fit only for grazing, and can never be profitably used for any other purposes. The laws should, therefore, be amended by adding another, or "Pastoral," grade to the Public Lands Schedule, and with authority for leases alone to be made to persons wanting such lands in tracts of not less that 20,000, nor more than 300,000 acres to each lessee, for terms of twenty years, which would prevent these lands being monopolized by a few persons to the detriment of others, and would yet give to the tenants security in those proprietary rights necessary to prevent trespassing by others, or disturbance from Government agents or officials.

As I have before intimated, these lands can never be converted into agricultural lands, notwithstanding the various schemes proposed from time to time for their irrigation and reclamation from agricultural sterility; for there are physical causes for that sterility which neither the power nor the ingenuity of man can change, and it has been thought that a brief discussion of these causes might not be uninteresting to the members of this Convention, and I have been asked to give you views in regard to them.

To do this will, of course, involve a wider range of investigation than if the

simple facts and conditions of the problem were accepted without going back to their origin or cause through the meteorological processes by which these facts and conditions are brought about.

I will first call your attention to this skeleton map of North America, where only the main ranges of mountains, chief lakes and principal rivers are laid down, other details being omitted so as to prevent confusion.

The principal range of mountains extending through Central America into Mexico is a continuation of the Andes of South America. In Mexico, however, these mountains are known as the "Sierra Madre," or "Mother Range," and which throws off two branches—one to the northwest along the Pacific Coast into California, where it is known as the "Sierra Nevada" or "Snowy Range," and which runs thence up into Oregon, where with a lower altitude to the range, it assumes the name of the "Cascade Mountains," and where it is broken into a number of detached, isolated but majestic peaks, such as Mounts Jefferson, Hood, Adams, Ranier, St. Helens, etc., etc., which stand as hoary sentinels surpliced in eternal snow to mark the gateways through which the moisture-laden winds from the Pacific Ocean gain access to the heart of tne continent.

The other and in many respects the grander branch from the Sierra Madre is the Rocky Mountain Range, which runs almost due north about the 110th and 120th meridians of longitude, until reaching the parallel of 45° N. latitude, where this range sinks to an elevated "divide" of from 6,000 to 8,000 feet above the level of the sea.

Lying between these ranges, and extending from the Sierra Madre to the Yellowstone Park, lies a plateau or plain of comparative sterility and barrenness, comprising much of the territories of Utah, Arizona and Nevada.

With this preliminary description of the map, I shall now proceed to discuss some of the meteorological phenomena that have a direct bearing upon the question before us.

It is generally believed that the sun is the direct evaporator of humidity and especially of the ocean waters, and that the evaporation from the oceans is mostly from the equatorial regions of the earth, and that the vapor from this evaporation is transported by the winds through the upper regions of the atmosphere directly north and south, to its points of distribution in the temperate and frigid zones.

This, however, I think is a fallacy, and that in reality, notwithstanding the enormous evaporation that does undoubtedly take place in the equatorial regions, by far the greater part of that evaporation is precipitated back to the earth's surface within the tropics, and that by quite a different process are the regions of the earth beyond the tropics supplied with water from the heavens.

The sun's rays being more nearly vertical within the tropics, have so much the more heating power, and the surface waters of the oceans there are thus brought up to a general temperature of 88° F.; from whence this heated water is carried north and south to the earth's extremities, by grand ocean streams, which are the life-giving arteries of the oceanic and inter-oceanic circulation.

Of these streams there are four, the two grandest and greatest of which are thrown off to the southward, from the equatorial currents of the Pacific and Indian Oceans; whilst the remaining two are thrown off northwardly from the tropics into the north Atlantic and Pacific Oceans. The first of these latter is the Gulf Stream, whose general character is familiar to us all. The other is the Kuro-Siwo, of more recent discovery, which starts from the southeast coast of China, and running northeastwardly with a velocity of from thirty to eighty miles a day, and losing only 1° of warmth for every 300 miles that it travels, washes the south coast of Japan, and spreading a mantle of tepid water of upwards of 70° of temperature over the surface of the north Pacific, envelops the whole west coast of our continent from Behring's Straits to the Equator with its genial warmth, and gives to that region the delicious climate which is now becoming so well known to us all.

Now, whilst the sun by its heat in the tropics has prepared these waters for rapid evaporation by giving to them their high temperature, yet the sun itself cannot and does not evaporate any portion of them, except through the medium of the atmosphere. And the power of the atmosphere to produce this evaporation is in exact proportion to its low temperature and its dryness as compared with the water at the time of its contact with these tepid waters from the Equator.

The prevailing winds in the temperate zones are from the westward. The west winds which come to the north Pacific from the plains of Central Asia and Siberia are cold, contracted and dry, with a temperature frequently below the freezing point, so that when they reach the tepid waters of the Kuro-Siwo they at once respond to the warm and expanding influence of these tropical waters, and as they expand drink up by evaporation prodigious quantities of the latter, which, as invisible vapor or fogs, are borne eastwardly across the surface of the ocean to the west coast of our continent.

That portion of these winds that reaches our coast about the mouth of the Columbia River are chilled by the Cascade Mountains, and made to yield such quantities of rain as to have produced a forest growth of vegetation so rank and majestic as to be unrivalled by any other forests of North America; and just north of the Cascades come the open gateways through the mountain ranges, guarded only by the detached and hoary peaks before named, between which these west winds carry their burdens of warmth and moisture to gladden and fatten the face of the interior of the continent, but which on their way pay such tribute to these majestic sentinels as to clothe and crown them in the purity of everlasting snow, and then reach the elevated region of the Yellowstone Park with still abundant moisture, which is dealt out from their hitherto invisible treasures with such royal profusion as to give birth to and keep in perennial flow the grandest system of rivers on the face of the globe, viz: the Columbia, McKenzie, Saskatchawan, Assiniboine, Yellowstone, Missouri and Colorado, which, radiating north, east, south and west from this immediate region, and with courses of thousands of miles, each distribute their waters into all the oceans surrounding

the continent. This may, therefore, be not inaptly called the "*Water Dome of North America!*"

Stretching eastwardly from this "Dome" to the mouth of the St. Lawrence River on the Atlantic Coast, lies a declining ridge, from which waters run north into Hudson's Bay, and south by the Mississippi, Illinois and Ohio Rivers and their tributaries, into the Gulf of Mexico, and east of the Alleghenies by the Potomac, Delaware, Hudson, Connecticut and other rivers into the Atlantic Ocean.

Besides all these mighty rivers that have their geneses in the direct pathway of these west winds across the continent, and cradled upon the crest of the ridge just described, lie the great Lakes of Superior, Michigan, Huron, Erie and Ontario, which alone are estimated to contain one-half of all the fresh water resting upon the face of the earth, and which, notwithstanding the necessarily enormous drain from them by evaporation, yet have always such a surplus of water as to keep in unvarying flow from them the majestic St. Lawrence River.

Now the waters which supply the rivers radiating from what I have termed the "Water Dome," all come from this west wind from the Pacific, as I believe do also those which supply the other rivers in the Mississippi basin west of the Allegheny Mountains, together with those that fall into and make the great lakes. Whether or not the waters that go into the rivers east of the Alleghenies come from the same source is doubtful. I think, however, that through local agencies, they come from the gulf stream of the Atlantic. Yet it is not unreasonable to believe and affirm that by reason of the waters that do come from the prevailing west winds from the Pacific that it is the *Kuro-Siwo of the Pacific that irrigates and fructifies the heart of the continent of North America.*

Now it may be asked, what has all this to do with the aridity of the alkaline plains of Colorado and New Mexico? Very much, as I shall endeavor to show, by first calling your attention again to the water supply that is carried under the wings of this west wind from the Pacific Ocean and distributed nearly, if not quite, across the continent (when not interrupted by the condensing power of intervening mountain ranges,) since that is the gauge by which the quantity of water carried by these winds can be measured; and if found in one portion of these winds, it is not unreasonable to believe that other portions of these same winds carry a corresponding quantity. But let us now see what becomes of that supply from that portion of these winds which strikes the land south of Oregon, and which, being slightly chilled by the coast range of mountains and hills, give out moisture enough to envelope the coast with fogs and clouds during many months of the year. Passing thence into the interior, these winds are thrown upward against the cold flanks and peaks of the Sierra Nevada, where being condensed, they crown the latter with their coronets of eternal snow. Descending the eastern slope of the Sierra Nevada Range, these winds reach the plateau of Utah and Arizona before described, so robbed of moisture that the earth's sterility is but the evidence of its unslaked thirst.

Continuing eastwardly, these west winds then climb the western slopes of the

Rocky Mountains, but without moisture enough in them to clothe with vegetation the rock-ribbed walls whose sombre and rugged nakedness attest the infrequency of rains upon them. Still the altitude of these mountains is so great, and therefore so cold, that their supreme peaks wring from the shrinking winds what little moisture remains in them, to add sparkling coronets of snow also to their majestic heads. But these winds, pitching thence down the eastern slopes of the Rocky Mountains, reach the plains of Colorado and New Mexico so completely dry as to be unable to give forth even a morning dew, and hence the alkaline sterility of these plains, which no human intervention can change or alleviate.[1]

Now I hope it has been made apparent that these plains, as well as the plateau of Utah, Nevada and Arizona, owe their sterility to no accidental nor remedial cause, but to the immutable laws of Nature, which are not to be changed by man, and that these lands, as they stand, and will forever stand, are not fit for agricultural cultivation, except in rare localities along the water courses, but are especially fitted for grazing and cattle growing, and in my judgment should,

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1 If this meteorological hypothesis is correct, then similar phenomena should be found on the other continents.

Let us see if that is the case.

The west winds which we have followed across North America, on leaving our eastern shores, are cold, compact and dry, but as soon as they reach the tepid waters of the Gulf Stream, they at once respond to their warming influence and rapidly expand, and in expanding, take up by evaporation enormous quantities of water from the ocean, which they carry as invisible vapor or fog eastwardly across the Atlantic, to clothe the British Islands and Western Europe with their emerald robes of vegetation. Then that portion of them that is intercepted by the Alps is chilled and contracted so as to cap these mountains with perpetual snow, encircle them with profound lakes of marvelous beauty, and give birth to and feed the splendid system of rivers which, radiating from this "Water Dome" of Europe, discharge their waters into all the surrounding seas. Among these latter may be named the Elbe, Rhine, Saonne, Seine, Rhone, Po, Adidge and Danube.

The more northerly portion of these winds from the west, deflected somewhat by the Carpathian and Altai Mountains, pass eastwardly across Northern Russia and Siberia, and carry in their wings the water that gives birth to and feeds the Obi, Yennessi, Lena, and other grand streams that empty into the Arctic Ocean, and finally reach the Pacific as the cold, dry winds first spoken of.

It may be said, therefore, that the Gulf Stream of the Atlantic irrigates and fructifies the continent of Europe and Northern Asia.

Southern Asia receives its humidity from the tepid waters of the Indian Ocean, by means of the northeast and southwest monsoons, which prevail there.

Africa, being a tropical continent, is traversed by the trade winds, which blow from the eastward. These winds, saturated with moisture by evaporation from the hot waters of the great equatorial current that strikes the east coast of Africa, after its journey of 15,000 miles along the Equator from the west coast of America, sustain the rank vegetation which belts this continent in the tropical region, from the Indian to the Atlantic Ocean; crowns the mountains of the Moon with the magnificent lakes of Albert and Victoria, Nyanza, Tanganika and others, and keep in perennial flow from this "Water Dome" of Africa the majestic Nile, Congo and other rivers radiating from thence to the surrounding seas.

The great equatorial current of the Pacific and Indian Oceans, therefore, irrigates and fructifies the continent of Africa, through the agency of the trade winds.

In the same way is South America irrigated and fructified from the equatorial current of the Atlantic, by waters evaporated from it by the trade winds, from which their moisture is wrung by the cold flanks and yet colder summits of the Andes, from which flow into the Atlantic waters, the Orinoco, the Amazon, and the Rio de la Plata, with their myriad of tributaries; but when these winds have scaled the Andes, the extreme cold of the latter has so contracted and wrung from them all their moisture, that when they pitch down upon the west coast of Bolivia and Peru, they are as rainless as those arid winds which cause the alkaline plains of Colorado and New Mexico.

as a whole, be set aside by the Government for the encouragement of that industry alone, since the watercourses and water privileges are imperatively required by the ranchmen, and without which all the rest of the grazing plains are practically worthless.

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ST. LOUIS, Mo.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Jan. 20th to 31st.	Feb. 1st to 10th.	Feb. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	-10°.	-16.75°	-17.5°	-14.7
Max	45°.	50°.	31.	42.
Min. and Max	17.5°	16.75°	6.7	13.65
Range	55°.	76.75°	48.5	56.75
TRI-DAILY OBSERVATIONS.				
7 a. m.	11.4	23.1	-9.5	8.3
2 p. m.	21.0	31.1	16.7	24.6
9 p. m.	15.5	24.7	9.4	16.5
Mean	17.1	25.9	8.6	16.5
RELATIVE HUMIDITY.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Mean	. .	. .	. .	. .
PRESSURE AS OBSERVED.				
7 a. m.	29.219	28.905	29.080	29.068
2 p. m.	29.116	29.082	29.132	29.110
9 p. m.	29.192	29.018	29.139	29.116
Mean	29.176	29.001	29.117	29.099
MILES PER HOUR OF WIND.				
7 a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Total miles	2765	3737	3024	9526
CLOUDING BY TENTHS.				
7 a. m.	6.3	5.6	3.0	4.9
2 p. m.	2.5	3.5	2.3	2.8
9 p. m.	4.4	5.0	4.9	4.7
RAIN.				
Inches	0.54	0.03	0.3	0.60

Snow storms occurred January 22d and February 8th, 14th and 19th. The fall was only two or three inches at any one storm. The prevailing winds as usual at this season have been northerly. "Blizzards" prevailed January 27th and February 9th.

From January 20th to February 20th, the period embraced in this report, there has been steady cold weather with but little snow.

On the 10th of February the temperature was $-16.75°$, and on the 16th it was $-17.5°$. These were the lowest temperatures recorded this year to the present date. The 10th was the coldest day, the usual mean of the three regular observations being $-7.08°$.

A comparison of temperature observations of the last few years for January and February may be of interest:

	JANUARY.			FEBRUARY.		
Year	Min.	Max.	Mean.	Min.	Max.	Mean.
1881 . . .	$-11.5°$	$44°$	$16.9°$	$-6°$	$46°$	$23.0°$
1882 . . .	$8.0°$	$50.0°$	$30.6°$	$9°$	$68°$	$39.2°$
1883 . . .	$-21.0°$	$47°$	$17.8°$	$-21.0°$	$68°$	$25.7°$
1884 . . .	$-22.0°$	$59°$	$99.7°$	$-5.0°$	$67°$	$28.8°$
1885 . . .	-14.5	$65°$	$17.2°$			

If February continues cold for the next seven days these two months in the present winter will be the coldest of the past five years. The extreme low temperatures of 1883 and 1884 have not been reached, but the below zero days have been more numerous, and the mean temperature lower.

THERMOMETERS.

The severity of the past winter has invested thermometers with an unwonted interest, and it may not be unprofitable, at least to younger readers, to devote a short time to a discussion of the various kinds in most ordinary use.

As the expansion and contraction of the substance in the thermometer-tube indicates the amount of heat or cold prevailing, the definition of heat as a very rapid reciprocal motion of the small particles or molecules of matter is very appropriate, for heat expands all bodies, probably by producing more commotion among and causing their molecules to occupy a larger space. Liquids expand more than solids in proportion to the heat applied, and hence are ordinarily used rather than solids for thermometrical purposes; though some of the latter are probably more accurate and delicate, but less adapted to the more common uses of the instrument. Thermometers are based upon the facts that heat expands substances and that the same substance always possesses the same volume at a given temperature. Hence the liquid within the thermometer-tube should increase in volume to a much greater extent than the substance of the tube itself; otherwise it would not rise, but merely fill the expanded tube as before the heat was applied. Mercury and alcohol are the liquids used in the thermometers of the present day. In earlier times the air-thermometer was used, but of course was very unreliable as a heat measurer.

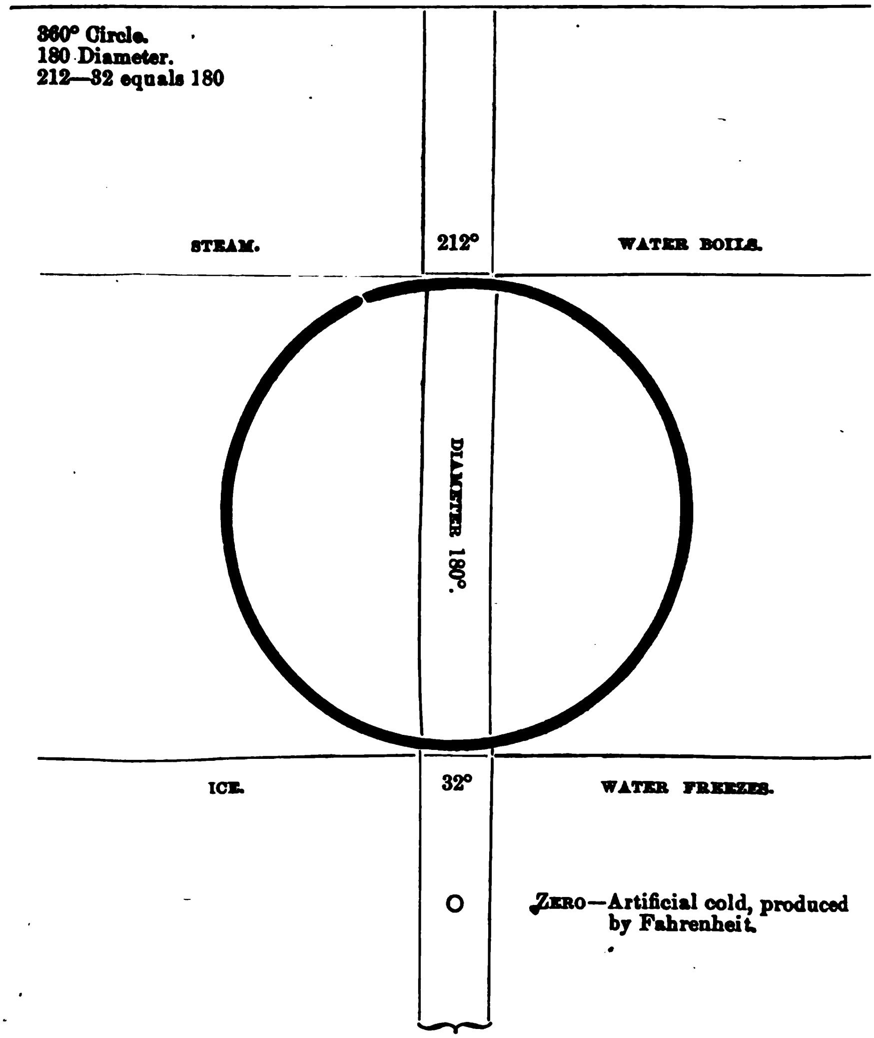
The thermometer was invented in the 17th century, and is attributed variously

to Galileo, Sanctorius of Italy, Drebbel of Holland, and to Robert Fludd. It seems probable that Galileo invented it—i. e. the air-thermometer—about 1602, for Castelli in 1638 says that Galileo had shown him one more than thirty-five years before. It was of glass, with a bulb "about as large as a hen's egg and a neck two palms long, and as narrow as a straw." A rude form of the liquid thermometer was invented in 1655 or 1656 by the members of the Florentine Academy, which possessed the advantage over the former of being hermetically sealed and not being affected by the pressure of the atmosphere. Edmund Halley, the English astronomer, introduced mercury in place of alcohol in 1680, though some writers give the credit of this use to Reaumur.

The scale of degrees fixed by the Florentines had for its fixed points the cold of snow on ice, and the greatest heat known at Florence, both rather variable points. Von Guericke, an experimental philosopher of Magdeburg, Germany, was the first to propose the freezing point of water as the lower limit of the scale, and Isaac Newton seems first to have discovered or made use of the facts that a thermometer placed in melting ice always indicates the same temperature and boiling water, when under a given atmospheric pressure, always has an invariable temperature. These points have been universally adopted by thermometer-makers as being most nearly invariable and the most convenient in practice. To find the freezing point, the bulb and tube are immersed in melting pounded ice or snow to nearly the height to which such cold will lower the column, until both mercury and glass are brought to the freezing temperature—the contraction of both thus being secured—and this point is marked on the glass. Inasmuch as water boils at various temperatures, dependent upon atmospheric pressure, purity of the water, the kind of vessel used and the state of the surface of the water, it has been found more accurate to take the temperature of the steam arising, which does not vary with these conditions. Accordingly the tube is held in the steam arising from boiling water at an atmospheric pressure of 29.92 until both glass and mercury are at the same temperature, when the point indicated is also marked.

Having secured these two fixed points, the graduation of the instrument is easy. The principal scales in use are Centigrade, Reaumur and Fahrenheit, the first having been proposed about the year 1741 by Celsus, who took the freezing point as the zero and the boiling point as 100°. This scale is most commonly used by scientists, especially in Europe. Reaumur established his zero at the freezing point and 80° as the boiling point. His thermometer is much used in Germany. Fahrenheit fixed upon 32° as his freezing point and 212° as that of boiling water, placing his zero at 32° below the freezing point. Various reasons are assigned for these differences in the scales. None, however, has been offered for that of Reaumur. As to that of the Centigrade, it is stated that according to the historical notes contained in the meteorological observations of Lafou, President of the Meteorological Commission of Lyons, the first thermometer ever seen there was exhibited in 1736 by Duhamel. This thermometer was constructed with alcohol according to the scale of Reaumur. Christin, a member of

the Lyons Academy substituted mercury for the alcohol, introducing a qua whose volume might be represented by 6600 at the temperature of fre water. Having raised this to the temperature of boiling water he found volume of the mercury increased to 6700, or 100 parts. This suggeste division of the tube between these fixed points into 100°; and this, accordin this authority, was the origin of the Centigrade thermometer; although as b stated, its invention is generally credited to Celsus about six years later.



Fahrenheit kept the reason for his graduation of the thermometer a secr d it has been supposed that his zero point, 32° below freezing, was the low

artificial temperature he was able to produce, or perhaps the lowest natural temperature observed by him in Iceland, but recently a novel explanation has been published by an anonymous writer in the Ohio State *Journal*, which is described and illustrated as follows:

Fahrenheit was a mathematician and knew that a circle was divided into 360°. He found that steam and ice were the most natural fixed points in temperature, at opposite poles. He therefore naturally divided the distance on his glass tube between ice and steam into the number of degrees in the diameter of a circle, which is 180°. He wanted an instrument which could be cheaply made and which would measure above steam and below ice, so far as would be commonly used in everyday life. He found that artificial cold could be produced which would cause the mercury to fall just thirty-two of the spaces he had marked off on his glass between ice and steam, and he there, whether sensibly or not, placed his zero or point from which he would count. Hence ice, or freezing, is 32° above, and steam or boiling water is the diameter of his circle, or 180° above ice, or 212° above zero. This may appear very *novel and ingenious*, but its utter absurity is apparent when we remember that the diameter of a circle is not 180°. We only refer to it here because we have seen it prominently copied in respectaand influential newspapers.

In converting degrees of one thermometric scale into those of another the following formulæ may be used:

Centigrade	Degrees	$\div 5 \times 9$	$+\ 32=$	Fahrenheit	Degrees.
Reaumur	"	$\div 4 \times 9$	" $32=$	"	"
Fahrenheit	"	$-32 \div 9 \times 5$	$=$	Centigrade	"
"	"	$-32 \div 9 \times 4$	$=$	Reaumur	"
Centigrade	"	$\div 5 \times 4$	$=$	"	"
Reaumur	"	$\div 4 \times 5$	$=$	Centigrade	"

Mercury expands quite regularly between —36° and 212° F. Above 212° the expansion is less regular and the indications less exact. As mercury boils at 660° F., the limit of the scale in this direction is sufficient, but since it freezes at —38° F., alcoholic thermometers must be used for lower temperatures, for this liquid has never been frozen.

Thermometers for maximum and minimum temperatures have been invented by several persons. They are self-registering, and this is effected by a small index within the tube which moves with the mercury in one direction and not in the other.

BIOGRAPHY.

PROFESSOR BENJAMIN SILLIMAN, JR.

H. E. SADLER.

The death, on January 14th, of Prof. Benj. Silliman, "Young Ben" as he had not ceased to be called though he died in his sixty-ninth year, has not been chronicled in the dispatches of the western press. This was, perhaps, to be expected, for Prof. Silliman was in no sense a leader of scientific thought. He had hit upon no such discoveries as those by which Henry opened the way for the telegraph or by which Bell has produced the telephone. He had not pushed speculation to the limit of human reason. He had not been the founder of any school of philosophy. Even in his chosen field of chemistry it has fallen to his colleagues, to Cooke, to Gibbs, to Lawrence Smith, to extend the written laws of nature and make the broader generalizations.

And yet who is left behind to whom the cause of science in America is more indebted? While acting as assistant to his father, so early as 1842, when there were yet no schools of science in this country and when even in our best colleges such instruction was given only by lectures, he fitted up a laboratory at his own expense and gathered about him a few earnest students in physical science. The dinginess of the "old lab" on the Yale campus, whose unloveliness associations have hallowed, and the atmosphere of the college green, supersaturated with Greek, would have stifled a less vigorous shoot, but after five years this bud of promise struggled forth into light and blossomed. In 1847 the Corporation named Tutor Silliman "Professor of chemistry applied to the arts," organized the Yale Scientific School, enrolled his students on the college catalogue, and appointed one of them, the lamented Jno. P. Norton, professor of Agricultural Chemistry. No longer quite single-handed, but still without other than his private resources, he engaged and equipped a larger building and made room for the students who came flocking in, zealous in the new departure. And of them all, how many drew from his untiring enthusiasm the elements of their success; the genius of hard work, the love of learning and of truth, the ambition to contribute to the world's store of knowledge, the spirit of research? How many, too, of those early disciples have continued in the paths then taken, not without reward to themselves and gain to us all. Samuel W. Johnston, Brewer, the lamented Norton, Geo. K. Brush, Daniel C. Gilman, such are the names these memories ll.

An educational revival of this character could not wait long for recognition d support. Under the skillful management of Prof. Silliman, endowments quick succession, and when he was called to Louisville University this

offspring of his heart and labors had, by the benefactions of Sheffield, been placed on the high road to prosperity. Immediately other scientific schools, technological institutes, and industrial colleges, began to follow in the lead, until to-day we see them scattered as widely as our common schools.

Yet this was not all, for Prof. Silliman continued a teacher to the end; nor should we forget that physicists like George F. Barker were his pupils, that naturalists like Marsh own his guidance, and that through his influence, perhaps more than any other's, the munificence of the great philanthropist laid deeply the foundations of the Peabody Museum, with its already startling achievements.

But others, whose evidence is not hearsay, are telling more vividly the story of the debt we owe him. After all, lighting the fires of that educational revolution of the fifties was not furnishing the fuel, nor could the momentum of the new engine on the highway of learning be maintained by projecting into it the Nortons and the Gilmans. Science was yet to be popularized and the *raison d' être* of technology must appear.

Probably no chemist in America has so often acted as consulting expert. New and great industries, like petroleum, have arisen at his bidding and everywhere experiment and waste have dwindled at his command. Besides the early applications of science with which his name is linked, and the reports upon matters referred to his committee by the National Government during the war, I recall, among a multitude of others in recent years, laborious investigations upon water-gas for illumination and fuel, upon the purification of coal-gas, upon marbleized or granite iron-ware, upon the fitness for industrial purposes of the water supply of towns, and upon the burning of bagasse and other wet fuels. This but hints at the variety of his studies and the range of his association with men of affairs. It is to works like these that we must look for the continuation of the liberal support which even pure science is now receiving from the productive arts.

"To love her," said *The Tattler* of Lady Hastings, "was a liberal education." To have access to Prof. Silliman's study, was to lay the foundations of character. It was to make all lovely things seem still more lovely, to learn the worth of easy circumstances, of domestic peace, of gentle sympathy, of devotion to duty, of learning, manners, and modesty, of simplicity when fortune smiles, of unswerving fortitude when she frowns. His library was a large room, blending by ample bay window with the garden. Its stretch of floor was broken by thick and kindly rugs, by escritoire and reading desk, by map cases, easels, and quaint chairs. Its mantel over-arched a grate of flaming coal which cast a glow like the peaceful love that reigned there. Piled high around were line after line and tier after tier of scientific periodicals and books, most cherished if not sole return from half a century's devotion to the *American Journal*. The sustained and serious, but bright and cheerful, occupation of the family, the earnest but above all kindly face of the master, complete a picture such as we love to hang on memory's wall.

Although the scientific work of Prof. Silliman extended through a round fifty years, the number, variety, and laboriousness of his contributions show how systematic and incessant his labors must have been. What he has accomplished, however, will be appreciated only by those who know how manifold were his interests outside of science, by those who have learned the prodigality with which he bestowed his time upon his pupils, by those who remember his remarkable faithfulness to the humblest duties, even self imposed.

I first sought his aid when interested scientifically and financially in the new water gas manufacture. At once his own library and, through his intercession, the laboratory of the New Haven Gas Company, to which he was consulting chemist, was placed freely at my disposal and he undertook gratuitously the direction of my investigations. In sickness and health, in rain and shine, through a long year his kindly face brightened daily the doorway of that remote and inaccessible room, "just for a little encouragement, you know," as he would say when I insisted that no help would be needed to-morrow. I soon had opportunity to disabuse my mind of any suspicion that this was through partiality for me, for it became evident that all his pupils were made to feel the same privilege of trespassing on his time. Certain attorneys from New York beset him one day to give evidence in a patent case, insisting that the large interests of their client hung upon his testimony. But he answered very firmly that while he had always felt that a scientific man ought to be the servant of the people, especially of their courts, and while he would be very happy to assist in establishing the justice of their client's claims, of which he happened to be in a position to be well assured, he was yet before all things a teacher, that he had a class of six students looking to him for daily direction and advice, and that he could not consent to leave New Haven for a month yet, or until his first business was done. The court held the case open till that class had completed its course in chemistry.

There was another element of Prof. Silliman's character which contributed not a little to his influence over his pupils. From youth he had been a traveler. His work had called him into all portions of the Union, into contact with all classes of society; into the barracks of the mill hands, the cabins of the miners, the salons of the proprietors. He had studied the petroleum of Southern California, the mines of Oregon. He had written for New Orleans the first course of lectures upon agricultural chemistry ever delivered in this country. In a high social position, as representative of an old and honored family in his State, the editor of a journal, in its department, *facile princeps*, one of the original fifty of the National Academy, he had lived on terms of intimacy with the learning and the culture of the land. He had visited abroad with his father, the honored guest of the scientific societies of Europe, and in turn he had entertained at home the most distinguished representatives of learning from England and the continent. His mind, broad by cultivation and sympathetic by nature, had reaped the full benefit of these associations, and with his manners, simple indeed but at all times

easy, he was enabled to enter at once into the thoughts and hearts of his pupils and draw them in turn into his own.

So he lived, modest in demeanor, not flaunting his achievements, choosing good deeds, and pursuing steadily the path of duty. His life, his words, his works, his rewards, were a perpetual inspiration to the scientific spirit, the love of truth for truths' sake, to a zeal for research, to an eagerness to bestow upon the arts the latest results of science, to a faith that the multiplied interests of a community were one and single. Neither luxurious nor penurious in his habits he saved a modest competence and for the rest spent liberally a handsome income, an income derived not from his chosen profession, for from the founding of the Yale scientific school he too often paid his own salary, and many an earnest student can testify how freely his time, and means as well, have been forced upon his pupils. That was the use he loved to make of the dollars he received from the industries to which he had saved fortunes.

Withal, his life knew its sorrows, none deeper, I think, than the calumnies which befell him in connection with the Emma mine. It was in 1869 when the independents who afterwards started the Greely movement were decrying "Grantism" in all its forms, and calling especially for purity in politics, that a suspicious connection with that ill starred English investment was fastened upon General Schenk, our minister at St. James, and he was made the object of the most unlimited abuse. The virulence did not end with him, but Prof. Silliman was included in the scandal, the whole opposition press being free in its insinuations that his favorable report upon the property was unjustified and corrupt. In vain he courted congressional investigation and sought any opportunity for his vindication. It did not come till 1877, when the principal, Trevor W. Park, was sued by the English bond-holders. But by that time the public had lost all interest. General Schenk was no longer an issue in American politics. It was too late to erase from the popular mind the blot on the chemist's good name.

He had hardly emerged into the penumbra of this shadow, when the death of his loved wife again darkened the day. Then came sickness, financial embarrassments, the infirmities of age, thickening to the end. But under all and through all he remained the same genial and faithful worker and guide.

The attacks which embittered the last years of his revered father seem to have been more provoked and easier to have avoided than the cup of gall which was given to the son. He told me once with great feeling how the genial Emeritus arose in a meeting in which the need of men for Kansas and the cause of Free soil had been debated, and said: "It is not men we need for Kansas so much as courage to fight for the right. I will be the first to give a rifle and brace of revolvers to one who will use them in the Free soil cause; who will give another?" and a hundred voices answered "I." He had pulled the trigger of a loaded gun. Throughout the North shot the cry "a rifle for Kansas." The The New Haven colony at Wabaunsee stands to-day a monument to that inspiration. But the sequel was less fruitful of good. At once from strangers and friends, from former hosts and guests, from old pupils and colleagues, there

poured in letters so cutting, so vituperative, and so scurrilous that till his death, at the close of the war, it was found necessary to scan and sift his mail before he read it.

In many respects the son was weaker than his father; in some he was stronger. Living in and for his fellow men, he read eagerly all they said of him. He could not be saved from the bitterness of their censure. And now that he has laid down the burdens he had so nobly borne and rounded out the measure which it was permitted him to fill, let us cherish the more the lessons he has taught us, and keep warm in the hearts of men his perpetual memory.

KANSAS STATE NORMAL, January 20, 1885.

ARCHÆOLOGY.

"DID THE ROMANS COLONIZE AMERICA."

C. W. IRISH, C. E.

A labored article with the above caption appeared in the numbers of the REVIEW for September and November, 1884, Vol. VIII.

It is my purpose to examine the statements of Mr. Moore, the writer of said article, with a view to ascertain how much fact they may contain, and also what may be the value of those statements to the earnest student, who is striving, out of the meagre points in his possession, coupled with traditions and known customs of the present Indian races, to build up a theory which may account for the origin of the Red Man; at least as plausibly as we account for the origin of the White Man. That by patient study of all which we can gather, we may do so, seems probable, but then in my opinion it must be done by a more credible statement of facts and better founded arguments than has Mr. Moore advanced.

In the first place, why should we begin our study into the origin of the Indian by the enquiry of "From what far-off land came he?" It is plain, I think, that if we ignore the fact that the Indian may have begun his existence here, in the land where *we* now dwell, at the very starting point of our enquiry, we commit a serious error. But not so serious as to take up all the old myths of the Gentiles, Jews, Greeks and Romans, and those of all nations of antiquity whose tales of lost tribes and individuals have come down to us through the medium of history; and try to make those old tales, myths, and traditions true by accounting through them for the origin of the Indian races of America.

Another serious error made in such inquiries, is to assume that the Indian has lapsed into barbarism; to assume that away back in time his progenitors were cultured men, highly civilized and enlightened. How foolish the statements to the effect that "The pre-historic ruins reflect not only a high order of art but are

'founded upon pre-existent models known in old civilizations. This art displays 'a mind and hand trained in the schools of science."

How very foolish such expressions are can only be known to those who have had a chance to see such ruins. We know that the science and art of the pre-historic men of America almost wholly consisted in the manufacture of bows, arrows and spears, and implements of the rudest sort made of stone or bone. We know that his building operations in the main went no farther than the construction of rude mounds of earth, and here and there the erection of buildings of the same material, whose crude and rugged forms about as nearly approach the works of art and the buildings erected by men schooled in science, as does the humble ant-hill resemble a Greek or Roman temple.

It appears from all that I personally know of the American Indians, and have gathered from reliable sources, that they are races of men, who from the very beginning of their existence, *as* men, however distant that may be, have made but little progress in refining their pursuits, their habits and manners, or their arts and manufactures. In short, it is but little more than their form and language which distinguishes them from the brutes with which they associate. Nor does it seem that within them are the elements of progress, nor do they appear to have the power to lift themselves out of the brutish life which they have led for ages. For pre-historic implements and arms which we have been able to find, show by a comparison with the arms and implements in the hands of the Indians at the time of the discovery by Columbus, that in whatever time which may have elapsed between the advent of the Indian Adam and Eve, and the time of Columbus, be it much or little, the red man made but little improvement in anything whatever.

But to return to Mr. Moore. He says on page 237, Vol. VIII, of the REVIEW: "We consider first the most universal of the testimonies reflecting the 'Indian's origin. We say universal, for whithersoever the man wandered over 'the continent, he left behind him as a testimonial the shreds of his language. '* * * . The most common, and at the same time the most 'ancient of the Indian appellations have been preserved. They are the river 'names of the continent." Mr. Moore here assumes that each different tribe of Indians, in whatever its language may differ from the other Indian languages in its vicinity, uses in common with all other tribes the same names for the rivers of this country. How very far from the truth this is. For, as is well known, when a dominant tribe destroys or drives out a weaker one, the dominant tribe gives its own names to the streams, hills, vales, and other landmarks conquered from the enemy, taking pains in fact to destroy all that the weaker one had set-up or named. You might just as well expect a Chinaman to intuitively name the Rhone River in German terms on a visit to it, as to expect an Indian to adopt a name in his region coined by some one else. He never does it. Again, on the same page he says: "The Indian names of our rivers belong to a period when 'one common language was known, when one dominant race ruled throughout 'the entire length and breadth of America."

Mr. Moore then proceeds by a most astounding assumption to make it appear that the river names of America, meaning the Indian names of our streams, are derived directly from the most ancient of known tongues, the "Semitic." I will ask how does this statement accord with his other statement, that the prehistoric man was a man schooled in science? The Semitic tongue was prehistoric, and written language greatly preceded in time anything like science or schools of science.

I pass over much that he says about the terms "Aba" and "Na" in which he gathers up everything in the shape of words beginning with the different letters of the alphabet, from A to R, and tries to make it appear that they all come from "Abana." He quotes the two river names Niagara and Missouri, and endeavors to show that they are derived from Abana, meaning in these instances "restless, rapid, rushing current, a stream or a cataract." Pausing for a moment to remark that the African river Niger received its name from the Portugese, a people whose language is derived directly from the Latin, and that Niger is not at all the native name of the river, I shall state without fear of contradiction that the names of both the Missouri and Niagara are not the Indian names of these streams, but were also given to them by those white men who were the first to see them as discoverers, and were the names of the Indian tribe which happened to dwell on the banks of each, respectively, at the time of discovery. I shall give the Indian name of one of these rivers further on. He also pretends to derive the word Mississippi from the Sanscrit, or Dacian, and says that the original word was Messis-apa. Now, Mr. Moore must possess information which no other man possesses on this point, or else he makes an unqualified misstatement, for I have before me a copy (photograph) of the map drawn by Father Hennepin, and dated 1703. His travels in conjunction with La Salle were along this river in the years 1680–3. Now Hennepin spells the Indian name of the river on this map of which I speak, in one place Meschasipi and gives the meaning Grand River, meaning literally, Great, or Big River. In another place on his map, he spells the name Mississipi. On DeLisle's map, dated 1718, it is spelled the same as last above; and lastly, Captain Carver spells it on his map, dated 1766, Mississippi, and these men were the first ones to get the name from the Indians. Any one who has a knowledge of the dialects of the Algonquin Indian languages, knows very well that the termination of the river name in question, viz: si-pi, sip-pi, se-be, (as I have seen it written in more than one instance on old maps and in writings of the past century) is nothing more than attempts to spell the word meaning river in those dialects. In order that it may be seen that I am right in this matter, I here give the different spellings of the Algonquin word meaning river, as pronounced by various bands of that widely spread nation or family of nations, among which the discoverers the Great River traveled on their way to it, and while along it, and from whom they procured the name, given above and from which comes the name we know it by. The Ojibwa of Sault Ste Marie, Se-be (pronounced See-pee). Ojibwa of Grand Traverse Bay, Se-be (pronounced See-bee). Ojibwa of Saginaw, See-bea (pronounced

See-pea. Ojibwa of Michilimackinac, See-bee (pronounced as spelled). Miami, Se-pe-we. Chippewa, Si-pi (pronounced See-pee). Other bands of the Chippewas living north of the Great Lakes pronounce it Nee-pee, the spelling of which, as I have frequently seen it, is Ni-pi.

I have made it clear, I think, that the Indian name of the Mississippi comes to us from the Ojibwa or Chippewa, and that its meaning was or is "Big River." De Soto, on reaching its banks some years before La Salle, found that the Indians in his vicinity called it "Big River," and I know that the Sioux called it in Hennepin's time, and do to-day call it, Wak-pa-ha-ha; Wak-pa meaning river, and ha-ha meaning falls, or literally River of the Falls, for its great feature in their vicinity was the Fall of St. Anthony. I further know that from St. Anthony's Fall to its mouth, the river was known to all the Indians along its banks, as the "Big River," down to its mouth, except perhaps an Illinois band who called it Mis-seek-si-pi, meaning "The Grassy River," or better "The River of the Grassy Plains." Now I would ask of Mr. Moore his authority for his rendering of the word as he has it on page 241, Messi-apa. If it is possible to twist orthography and etymology so as to derive Missis-si-pi from Aba, Aub or Ab, then all we shall need in future research of the kind, is a Latin dictionary and a Sanscrit Bible. What is the use of a knowledge of the exact meaning of the words in any language if we are to do as Mr. Moore has done in his paper? To pick out certain words in an obsolete tongue signifying whatever they may, and then culling over the thousand and one tongues spoken over the world and taking from them all words which have a like sound with our selected standard, and then assume that they also have a like meaning with the words of our standard.

That Mr. Moore has done this in his paper I affirm, nor is he alone in this matter, for many writers have fallen into the same error, but have not been willful in doing so as Mr. Moore seems to be; for when the original word has not the slightest resemblance in its pronounciation to any of his so-called "Terms," he willfully misspells it, so as to make an apparent agreement. Mr. Moore on pages 364–5, Vol. VIII, wades through a large number of names derived from, or given by Spanish explorers to rivers and places in America, to prove that the Latin word *Aqua* was as he says: "Well and thoroughly known and correctly spoken 'by the native peoples of the American continent." Now I challenge him to produce a vocabulary of a native American tongue, in which the Latin word *Aqua* occurs, or any of its forms as spoken by people of Latin origin, and at the same time meaning water. I also challenge him to find a vocabulary of a native American language in which words, if there are any, beginning with Aq, Ag, Ack, Aqu, Agu, or any other forms, having a similarity with the words Aqua, or Agua, in which the said native American words have a meaning expressive of the word water. It is plain that all the names which he quotes, and which have come to us from Spanish geographers, are words of their own invention. The Spaniards, who with their priests, of the time of the American discoveries, were noted for refusing everything native, abhorred the natives, for they were heathens, and refused them a place in their literature. Hence we know less

about native manners, customs and languages in countries of Spanish discovery, and over which they have dominated, than any other. How funny Mr. Moore's meaning as he gives it, of the river name Orinoco, is, when we know that it means in the native language of that region "Crooked River." He makes it "Orien-aqua," or "River that runs towards the sunrise." On page 367 he renders Michilimackinac, first into Mackinaw, from which he makes an easy jump into "Ma aqua-na." It is well known to every school-boy in this northwest that the work Michilimackinac was the name given to a certain island near the Straits of Mackinaw by the Chippewa Indians, and means "Turtle Island." I would ask Mr. Moore where he gets his term Aqua, meaning water, out of the above true meaning?

On page 368 he again refers to the river names Mississippi and Missouri, which I will notice in passing, to say that I have fully disposed of the origin and meaning of the first, and now assert that the last was never the Indian name of the river to which it is now applied, but was given to it by the white men who first traversed the country from its mouth westward, because the powerful tribe of Indians which they found along its valley were known by the name of Messourias, which name, now changed to Missouri, is given to the State and river. The ancient Indian name of the Missouri was Pekitanoni-si-pi, a name given to it near to its mouth, doubtless by the "Illini" Indians. I have not yet ascertained the meaning of the name, but I do know that all the tribes living along this river above Council Bluffs, call it the Big Muddy River. The Sioux call it almost universally Min-ne-sho-sha Tanka, literally water, dirty, big. Where then is the claim of Mr. Moore to rest, that the word Missouri means "the gathering river?" His statement to that effect is the purest nonsense. Equally so his statement, that the word Jehovah in any sense or form occurred in the ancient Choctaw tongue.

Now, the syllable Chuc, which Mr. Moore makes do duty for the expression Great Father, or God, has in its forms of Chi, Che, or Chu, quite a different meaning. For instance, here in Iowa we have a river, the ancient Indian name of which was Chi ca-qua-se-po. Taking his analysis for the meaning of this river name, we have Chic—God, or Father, Jehovah, aqua,—water, and as se-po means river, he would render it God's Water River, and he would go into rhapsodies over his supposed great discovery of the scolastic knowledge of the Latin tongue by the breech-clouted Indian who named this river. Now let us see what the name of this river means in the Indian tongue to which the words belong. It is Algonquin, and in that tongue Chi-ca means a stink or bad, strong smell of any kind, and as applied and modified in this instance it means Skunk, or strong stinking animal, hence the Indian name of this river rendered into English is Skunk River. Now how divine it does appear, and how scholarly the Indian must have been; "schooled in science and the Latin language," to be able to give the stream such a high-sounding title.

The word Chicago is also of Algonquin origin, and in the case of the city of ha t name means Onion, which is a strong smelling plant, and was gathered in

great quantities by the ancient aborigines along the Chicago River (Onion River) and over the marshy flats adjacent. Mr. Moore would have us believe that the name means the City of Jehovah! What a drop there is, from his Latin afflatus down to the level of Indian simplicity! On pages 370–1, Vol. VIII, Mr. Moore says: "In some of our northwestern States the term 'Minne' is often found in 'the native Indian names of waters * * * . It is 'evident that some natural fact gave birth to the expression 'Minne.' What was 'this fact? * * * Geology and physiography unfold 'their testimonies. * * * The English pioneer pushes 'into that same northwestern country and everywhere the same natural facts pre-'sent themselves, and they are marked down on our maps simply the red or the 'vermillion, and if we look into the geographical literature of the country, there 'we shall find the Great Red River (of the North), Vermillion Lake, Red Lake, 'etc. Underlying the country are vast deposits of red clay, red sandstone, and 'vermillion earth. Many of the waters there have in consequence the reddish 'tinge. * * * If we open our authorities on language 'we find in our Indian 'Minne' merely the Latin *minio*, which in plain English 'means precisely the red or the red vermillion clay. It would be difficult to find 'verbal testimonies more conclusive than in those Minnesota names. * '* * The legend says that Minne-ton-qua means 'thundering water.' 'The Latin has *tons* for thundering and the 'qua' is but an abbreviation of *aqua*. 'Minne-ha-ha reveals one of the Roman idioms, etc. In analyzing the word 'Minne-h-aha we discover a superfluous h. * * * By 'reference to authorities on the Latin language we find that the letter h is often 'an abbreviation of the word *habeo*—to hold. The word Minnehaha would 'therefore mean river that holds red or vermillion clay. The waters do hold the 'red element for a long distance."

In the above quotations we have Mr. Moore's attempt at derivation of the words Minne Tonka (not Ton-qua as he spells it,) and Minne-ha-ha. It is proper to say that these names come from the Sioux or Dakota Indian tongue. The word which signifies water in that tongue is Min-ne; it in no sense is taken to mean red. The Sioux words meaning red are Sha, or Duta, the last properly signifying scarlet. The word signifying thunder in that language is Wa-kin-yan, also the word signifying big, or great, is Ton-ka.[1] And again the words Min-ne-ha-ha signify waterfalls, ro literally, curling waters, and is always applied to waterfalls. The words Min-ne Ton-ka signify Water Big or Big Water. Here I must say that the lake so named up in Minnesota got its cognomen from Governor Ramsey of that State. Its Indian name (Sioux) was Mde Tan-ka, Lake Big, or Big Lake. There is perhaps no other State in the Union having so much lake area of pure clear water as has Minnesota, and there is not a lake, or pond, large or small, in the State which has a tinge of red in its waters, nor even so

1 The *n* in each of these words has the nasal sound of *n* in bring, and the *h* in the word ha-ha has a rude guttural sound very much like the sound one makes in hawking a fish-bone from the throat.

much as muddy water within its banks, that I can recall; and I have travelled quite extensively in Minnesota, and have noted very particularly its superficial and topographical features. The small stream which gives outlet to the waters of Lake Minne-tonka is the one which gives rise to the Falls of Minne-ha-ha, its waters falling over that cascade, and although there is an underlying bed or stratum of red clay throughout the region of the lake, and creek, and yet it does in no way give a tinge to the waters of the lake nor to its outlet stream.

It is a well attested fact that throughout the region of Dakota Territory and the States of Minnesota, Wisconsin, and Iowa, there are several underlying strata of red clay, and of red sandstones, yet in no instance known to the writer do these red materials tinge the waters red, nor are they reddish in any instance where they approximate the surface of the ground. Now this being true, what becomes of Mr. Moore's statement to the effect that the waters of this region are so tinged as to readily suggest such names as Red Lake, Red River, etc? The Sioux words Minne-ha-ha signify waterfalls, not "water holding red clay." The Sioux words signifying Red Water River are Wak-pa (river), Minne (water), Sha (red); Minne always signifies water in that language. Then how can this word come from, or be derived from the Latin word *minio?* (red). The Sioux word Ton-ka signifies big or great. How then can it be derived from the Latin word *tons* (thundering), and again, if Governor Ramsey invented the name of the lake, using two Indian words which signify Water Big, or Big Water, how, I ask, is Mr. Moore to derive it from the Latin to thunder, thundering, etc.? It is plain, I think, from all that I have discussed of Mr. Moore's paper, that he is entirely wrong in his statements of fact, and in his deductions. He evidently believes that all the Indian languages of the western continent are but dialects of one original mother tongue, a belief very far from the truth. Fortunately for the archæologist, the Indian tongues come to him in their purity, not having that dilution of terms and phrases which characterized the languages of the eastern continent centuries before an attempt to systematically study them was made. I will say here that not only Mr. Moore, but many others, have been greatly misled in attempts to study and to account for the peculiarities of Indian languages, manners, and customs, by the assumption in the outset, that not only the human family, but all spoken languages, have had the same point of origin. Of these students Mr. Moore shoots the widest of the mark. For if he has either willfully or unwittingly made the misstatements and errors in regard to words belonging to the Sioux or Dakota, and the Algonquin languages, as I have pointed out, then we must believe that he has been equally faulty in his investigations into the meaning of all the words which he quotes from the various American Indian tongues in his paper.

I therefore come to the conclusion that as far as Mr. Moore's researches are concerned, we have no reliable proof that any known Indian language has been derived from the Latin, or in fact from any other known tongue of the Eastern Hemisphere, and I further conclude for the same reasons that the Romans *did not* colonize America.

IOWA CITY, IOWA, February, 1885.

CAVE AND CLIFF DWELLINGS OF ARIZONA.

REV. ISAAC T. GOODNOW.

Nine o'clock in the morning found us at Flag Staff, 344 miles from Albuquerque. By previous arrangement, Major J. C. Minor, land agent of the Atlantic and Pacific Railroad, soon appeared with his fine span of mules and in a rapid drive of twelve miles southeasterly, through woods and dales, soon brought us to Walnut Cañon, the site of the wonderful Cliff dwellings. With hardly any warning we approached it from a nearly level plain. Emerging from the pine woods which surrounded it, we suddenly found ourselves upon the brink of a deep chasm, said by Major Minor to be 1,000 feet deep, and perhaps of the same average width, though quite irregular. The sides consist of ledges of gray limestone, forming on each side of the cañon a succession of huge steps to the bottom, leaving room for a small stream of water. These layers of rock are perhaps from five to fifteen feet thick. Half way down, some of these ledges are overhanging, from six to twelve feet; the base rock having been crumbled or worn away, possibly in part dug out, leaving a space between the upper and lower ledge from six to twelve feet wide and from five to eight feet high. Here we find the cliff dwellings. The roof, floor, and back side of each dwelling is formed by nature, and it only remains for the inhabitant to build the front side and the ends. This was done with stone plastered together with mud, leaving a low doorway to crawl through. In front of the line of dwellings, nearly at the outer edge of the ledge, is a narrow roadway, or foot path, by which each one could reach his residence. These dwellings in some instances we found in two lines, one above the other, and in one case I found a third, but very short line. I made a personal examination of some thirty-five dwellings, some larger and some smaller, according to the space between the rocks. Major Minor estimates the whole number at 400; extending up and down the cañon five miles. Reckoning five persons to a family, it would give a population of 2,000 inhabitants. Near by among the pines we found fragments of pottery, plain and ornamented. The burial place for their dead has not yet been found, though diligently sought for by Major Minor, who some two years since discovered the dwellings; who inhabited them is a matter of conjecture. They must have preceded the present race of Indians who know nothing about them. And the problem is as much of a mystery to them as to us. One thing I have omitted to notice; approaching from the north—the cañon extending east and west—we struck it exactly opposite a high peninsula connected with the north side, half way down the cañon, by a low isthmus. This peninsula forms a partial division between the eastern and western portions of the cañon that come under our immediate inspection, and must command a fine view of both. I was limited in time and did not ascend to the top, though I examined the dwellings below on

its west side. The Major says the top was occupied as a fort. Certainly no finer site could be chosen. Thus ended our first day's work. On the second day, it being decided that the mountain of the cave-dwellers would be too difficult for Mrs. G. to climb, Major Minor very kindly invited Mr. Thomas and his nearest neighbor, Esquire Hicks, to accompany us. Our road led along the railroad track east several miles and then to the northeast up a beautiful valley, interspersed with handsome pines. We passed on our right a detached volcanic mountain with crater still extant, 300 feet across its southern rim, partly worn away. To the left upon a slight knoll in the timber, was a fort evidently to command the southern approach to the caves.

At the distance of eight miles from Flagg Staff, and I guess twelve miles in a northeasterly direction from the cliff-dwellings, we found ourselves at the base of a steep hill 700 feet high. This forms the southern extremity of a range of volcanic foot hills of the San Francisco Mountains. Ascending the hill at an angle of 45°, its face being covered with powdered lava thrown from the caves near the summit, we found it pretty hard work, as each step upward was sure to give way downward! The crust of this mountain was originally in a molten state, which gradually consolidated into a tufaceous rock, tough and hard. To form a dwelling place, a circular hole was made into the ground, probably to the bottom of what would constitute the floor of the principal room, and it was then rounded out into an oval or circular form, from ten to twenty feet in diameter and from five and a half to seven feet in height, leaving a sufficient thickness overhead to make a strong roof. Out of the main room some two or three other rooms extended; serving probably as sleeping or store rooms. In some cases a room was excavated much lower than the large room, probably answering the purpose of a cellar. Generally the dwellings had no connection with each other, but in some cases they had. At the top and southern brow of the hill was a fort with a part of the walls standing, some three feet thick. It extended east and west across the hill some sixty feet, evidently designed to defend the approach from the northern ridge, which is about on the same level. As a general thing these caves were arranged in parallel and semi-circles, commencing at the top of the hill at the south end just below the fort, and extending down the sides of the mountain, the lower circles being the longest. The entrances to the caves in some cases were near the middle and must have been by ladders, in other cases near one side, and might have been by stairs. Around many of the openings were circular walls, evidently constructed to guard against accidents or as a defense against an enemy. In some of these caves, well away from day light, were beds evidently used by bears or wild animals. As part of the time my explorations were by myself and beyond the hearing of my companions, even with a shout, the query did arise, while poking around with a long stick in the low, dark cellars, what would happen should I find Old Bruin at home? What gave special emphasis to such an enquiry was the fact that my only weapon of defense was a stick. After such reflection my stay in dark passages was not prolonged!

One of the largest caves was near the top by the fort and is supposed to have

been occupied by the head chief. It is thought there was originally an underground connection between this and the fort. If so, the passage-way has been filled and obliterated. Evidently rude and unfriendly hands have left the marks of destruction upon these unique dwelling places. The mouths of many have been completely stopped with large stones, others partially so. The conquerors did their best to render this city of the cave-dwellers uninhabitable. Major Minor, the original discoverer, three years since, estimates the number of the caves at 200. A more beautiful prospect as seen from this town site cannot well be found. East, west, north and south, mountain ranges clad with snow 7,300 feet high, intervening valleys, and detached knobs are commingled in a way to produce one of the most delightful landscapes in the world!

By an article in the March number of the KANSAS CITY REVIEW, I see that another village of the cliff-dwellers has been discovered; it is also situated on a volcanic foot-hill of the San Francisco Range, and is some fifteen miles from the cliff-dwellings of Walnut Cañon. It numbers sixty-five dwellings. The entrance to each is by a perpendicular square hole or shaft, extending from the surface to the floor of the main room at one side. Foot holes cut at convenient distances on the sides of the shaft, served as a stairway. A groove fifteen inches wide and eighteen inches deep, extended from the floor of the main room up one side of the shaft to the surface of the hill. Ashes at the bottom of the groove and the blackened sides above marked the fire-place and the chimney of the dwelling. In the cave-dwellings which I visited, the fire was built on one side of the large room and the smoke was left to find its way out of the circular opening wherever it was. We found fine specimens of broken pottery, plain and ornamental, with the metatas, or hand corn-mills, of the inhabitants, but nothing which would give us any insight as to the tools used in excavating the dwellings. On the other hand, in the interesting article referred to, mention is made of stone mauls and axes used in doing the work, with ornamental pottery, corn-mills, bone awls and needles of delicate workmanship, shell and obsidian ornaments, and implements of wood, the uses of which are unknown. Mr. Stevenson found evidences that satisfied him that the inhabitants here held communication with the cliff-dwellers in Walnut Cañon, but does not say what they are.

The preservation of wooden implements in these underground rooms, where they have lain for centuries with other relics undisturbed, demonstrates with marked distinctness the wonderful dry and preservative qualities of the atmosphere of this strange country. People here ought to live one hundred and fifty years.

We were particularly fortunate in our guide. In his antiquarian researches he is indefatigable and remarkably successful. One year since, at the great bend of the Colorado, seventy miles north, he found the ruins of a great city, extending along the banks of the river for ten miles. It was originally buried in sand after the fashion of some Egyptian cities, and afterwards brought to light again by the winds blowing from a different direction. The dwellings are of stone, two stories high, plastered with mud, similar to the cliff-dwellings. Major

Minor was successful in his search for their cemetery and procured specimens of pottery, etc., with all the skeletons, or remains of skeletons, he wished.

Mr. A. M. Sanford called my attention to the existence of a detached mountain of almost pure salt, situated on the Colorado River, 160 miles north of Kingman; ninety-five per cent chloride of sodium, and five per cent alumina. It is transparent like glass and print can be read through a mass a foot thick! The supply is inexhaustible and eventually must become a source of great profit. Mrs. Goodnow has specimens of pottery from the cliff and cave-dwellings and the newly discovered city, which can be seen by any one having a curiosity. While those from the last-named city exhibits most skill, there is a striking resemblance that assures one that the original inhabitants of all these towns were of the same nationality. In their building operations they adapted themselves to the peculiar features of that portion of the country in which they lived. Arizona in truth is a wonderland! We know comparatively little about it. If the little exploration already made, brings to light so many mineralogical, geological and ethnological curiosities and marvels, what may we expect when fully examined and carefully studied by the scientific travelers of the world?—*Manhattan (Kan.) Republic.*

GEOLOGY.

RAMBLES OF A NATURALIST AROUND KANSAS CITY.—III.

WM. H. R. LYKINS.

One day I sat upon an eminence overlooking the vast fertile plains of Kansas. It was a lovely day in October. A mellow, golden haze filled the air, softening the outlines of other hills which rose in the distance like the bold headlands of a sea coast. In the valley below were cozy farm houses embowered in the variegated foliage of fruit trees, and far away as the eye could reach lay yellow fields rich with the ripened fruit of the husbandman's labor. Herds and flocks pastured upon green meadows, and everywhere were men moving about like busy ants intent upon garnering their winter stores.

It was a perfect picture of the peace, prosperity and contentment of man. "It is, indeed, beautiful," said a voice echoing my thoughts, and turning I saw —or thought I saw,—standing beside me an aged man with a long, yellow beard leaning upon a ragged staff, and, like myself, contemplating the lovely landscape. "It is, indeed, beautiful," said he, "but it was not always thus. Listen!" he continued with sudden energy, "listen and I will tell you how it was. Ages upon ages ago I stood upon this spot. It was early morning and a hot mist obscured the view, but I could hear strange animal sounds, roaring, growling, snarl-

ing, hissing, and startling screams as if all the menageries of the world had been turned loose in this place, and, as the mist cleared away I saw a wonderful scene. Before me lay a vast lake, or inland sea, stretching far away to the north, bordered by a rolling country of rich savannahs and tropical forests, watered by many streams and rivulets, all teeming with animal life. Over the broad valleys roamed herds of elephants, the strange-tusked and triple-horned *Dinoceras*, and many other equally wonderful forms. In the forests monstrous beasts, the *Hadrosaurs*, half-bird, half-serpent, moved sluggishly, feeding on the lofty tree-tops. On the waters of the lake great turtles lay like floating islets; on the rocky reefs sea-serpents an hundred feet in length reared their crested heads and hissed at each other in horrid combat. In the shallows waded gigantic toothed birds like *Hesperornis*, while overhead the leathery-winged *Pterodactyls*—veritable flying dragons—fought in mid-air over their prey, uttering those piercing screams I had heard. By the water-side is feeding a herd of the peaceful *Oreodon*—that curious compound of the hog, deer and camel,—when a pair of ferocious *Drepanodon* or saber-toothed tiger dashes upon them, rending and slaying in the very wantonness of their brutal strength and power. Man, if indeed he has yet appeared upon the earth, has fled far from these savage scenes and sought refuge in the recesses of the mountains whose cold, blue peaks glimmered faintly on the western horizon. It was the *Age of Monsters*.

"Another age had passed away when I returned to this place. How changed the scene! One vast sheet of ice covered all the land. Nor bird, nor beast was to be seen; what few animals had survived the cold had fled far southward. The sun hung low in the southern sky, giving forth a pale and sickly light destitute of heat. An awful silence brooded over the scene, broken only by an occasional moaning, creaking sound as if Mother Earth was groaning in agony underneath the great monster that lay upon her breast. It was the *Age of Ice*.

"After another age, again I returned. As at the first time it was early morning and the sun had not risen, but through the gloom I could see advancing across the plain what appeared to be a monstrous serpent, roaring and hissing as it dragged its jointed length along, a single eye blazing in its forehead, shedding forth a baneful light. Surely, thought I, the Age of Monsters has returned again, but what monster is this, more terrible than any I have yet seen, which seems to devour the very earth before it! But as the sun rose and the light increased, I saw before me cultivated fields, happy homes, towns and cities, churches and school houses, and railway trains—even as you see it now. It was the *Age of Man*."

"Who are you?" I exclaimed in astonishment, turning to look at my companion again, but he had vanished, and I saw only in his place a bunch of the tall wild Sun-flowers, their yellow heads nodding gracefully to the soft southern wind which murmured musically through their leaves. I had been dreaming of the past, the present,—What will the *Future Age* be when this has passed away?

TERTIARY IN HARPER COUNTY, KANSAS.

F. W. CRAGIN.

EDITOR REVIEW:—If you have space for it yet in this issue of the REVIEW, I show like to record the fact that the tertiary in Kansas south of the Arkansas River can at last be definitely asserted to occur as far east as Harper County. A fossil presented to me from that county by Mr. C. D. Moore, and which was found at a depth of fifteen or twenty feet in digging a well, proves to be the large metatarsal of a Tertiary (probably Pliocene) horse. The fossil has been submitted to Prof. Cope, of Philadelphia, who states that it belongs to a type of horse different from any hitherto known, in having the lateral metatarsals (splints) more closely approximated than usual and *extremely unusual.*

I now refer to the Tertiary, also the conglomerate bed resting upon the Dakota sandstone near the east line of Barbour County. It is from this conglomerate and its former continuation eastward that the streams in that vicinity derive their beautiful array of colored quartz pebbles, and which, owing to its position—lower, as regards actual elevation, than are certain Dakota and all the Niobrara formations in Barbour and Comanche Counties—I formerly referred to the Cretaceous.

The pebble and gravel beds (largely white quartz) of Kingman County and southern Reno, are doubtless to be referred to the Tertiary also.

These developments indicate not only the absence of the Benton and Niobrara in Harper County, but also that the Tertiary is, in Harper County, brought down to within an unusually short distance of the Permian, following and immediately overlying the Dakota nearly to its eastern limit.

ASTRONOMY.

SUN AND PLANETS FOR MARCH, 1885.

W. DAWSON, SPICELAND, IND.

The Sun moves eastward about two hours, or 30°, every month. On March 1st its R. A. will be 22h. 51m.; declination 7° 19′ S. And on the 19th it completes the whole round of 24h., or 360°; passing the Vernal Equinox about 7:00 P. M., Kansas City time, that day. It also crosses the Ecliptic to the north, and by noon, March 31st, has a northern declination of 4° 25′, and R. A. 0h. 41m. March is often called a Spring month but, astronomically, Spring season

does not begin till the Sun reaches the Vernal Equinox. Spots on the Sun are larger and more numerous in February, to date (17th), than in January.

There will be an eclipse of the Sun March 16th, visible here as a partial eclipse; beginning soon after 10:00 A. M., and ending near 1:00 P. M. The Moon will be so far from the Earth that it will appear smaller than the Sun, and the eclipse will be annular, i. e. where it is central the outer edge of the Sun will be visible like a bright ring around the black Moon.

The path of central eclipse will strike the United States about 150 miles north to northwest of San Francisco; pass northeasterly into British America; cross Hudson's Bay and Greenland; leaving the Earth near 200 miles north of Iceland. There will also be an eclipse of the Moon, March 30th, about 10:00 A. M., and, of course, not visible here. But it may be seen on the opposite side of the Earth, nearly from Pole to Pole. For table of eclipses see REVIEW for August, 1883.

Jupiter and Saturn are now grand objects for evening observation. Saturn crosses the meridian soon after 6:00 P. M. in the early part of the month, and is inconveniently high for observation till 8:00 or 9:00, when it will have descended to a good position. The ring will continue at its widest phase with little variation for several months. Jupiter is a diamond beauty in the eastern sky; rising on the 1st, at 4:44 P. M. and southing about 11:30. Mercury is in conjunction March 13th, and will hardly be visible during the month. Mars is just passing conjunction, and will not be visible for some time. Venus is still a Morning Star near the horizon. It is declining northward and crosses the equinoctial March 31st, when it rises exactly east, half an hour before sunrise. Uranus comes to opposition on the 21st, when its R. A. is 12h. 5m., and declination 0° 21′ N.; being very near Eta, Virginus, and still nearer a small fixed star to the southwest. Neptune is still about where it has been for several months, a few degrees southwest of Pleiades.

THE ECLIPSE OF THE SUN OF MARCH, 16TH

PROF. W. W. ALEXANDER.

On March 16th, 1885, there will be an annular eclipse of the Sun, visible at Kansas City as a partial eclipse. The elements are as follows, by "Central Standard Time":

Conjunction in Right Ascension 12h. 14m. 23.6s.
Sun and Moon's Right Ascension 23h. 46m. 35.35s.
Sun's hourly motion 9.13s.; Moon's, 126.07s.
Sun's declination 1° 27′ 12.0″ South.
Moon's declination 0° 39′ 11.0″ South.
Sun's parallax 8.9″; Moon's, 57′ 7.7″.

From these elements may be deduced the following results: Central eclipse begins at sunrise, in the Pacific Ocean, about one thousand miles west of San Francisco; from this point it will sweep in a northeasterly direction; leaving the ocean it will enter the United States in Latitude 40° North, and cross the northern part of California and Nevada, passing over the great Salt Lake of Utah, and through the center of Wyoming and Dakota Territories. It will encounter British America and pass over Lake Winnepeg. Hudson's Bay, and Greenland, and continuing on in the same line, it leaves the Earth at sunset in the Atlantic Ocean about four hundred miles east of Greenland.

As seen from Kansas City the Moon will pass too far north to cover the Sun; so we will get only a partial eclipse, the northern limb and a little over half of his diameter being covered at the time of central eclipse, 11h. 55m. A. M.

The time of first contact or beginning of the eclipse here will be 10h. 30m. A. M., and on the northwest edge of the Sun is where it will first appear. Last contact, or end, will be at 1h. 20m. P. M., and on the northeast edge of the Sun.

In eclipses of the Sun we see no visible effects of umbra and penumbra on the Sun itself. We have the real (though invisible) Moon eating into the real and visible Sun, and along the line named above, there would have been a total covering or hiding of the Sun by the Moon, if its apparent size had not happened to be less than that of the Sun at the time of central eclipse.

To explain this I must give a few figures. As both Sun and Moon are round, or nearly so, the shadow from the latter ends in a point. The shape of the shadow, is in fact, that of a cone, hence the term "cone of shadow." Now, the length of this cone varies with the Moon's distance from the Sun. When nearest, the Moon will of course throw the shortest shadow. The lengths are as follows: when the Sun and Moon are nearest together 230,000 miles, when farthest apart 238,000 miles. The distance from the Earth to the Moon also varies as follows: when nearest together 225,000 miles, when farthest apart 251,000 miles. Hence, when the Moon is farthest from the Earth, or in apogee, the shadow thrown by the Moon is not long enough to reach to the Earth. At such times the Moon looks smaller than the Sun, and if she be at node we shall have an annular eclipse—that is, there will be a ring (*annulus*, Lat., ring) of the Sun visible around the Moon when the eclipse would otherwise have been total.

The most simple way to protect the eyes in watching an eclipse is to use a plain piece of glass smoked over a coal-oil lamp until it is sufficiently dark to obscure the glare of the Sun.

EDUCATION.

DIFFICULTIES IN SEARCHING FOR TRUTH.

PROF. S. H. TROWBRIDGE.

There is no end of theories upon all questions now vexing the public mind,—whether scientific, theological, social, political, or what not,—and he who cannot find among this maze of wisdom and unwisdom, plausibility and absurdity, a a doctrine to please him must be very hard to suit. The chief trouble is, the majority are pleased with too many of them. No mountebank can proclaim views so wild and absurd as to be without followers. Most men allow others to think for them. They simply absorb like a sponge, and, like it, as readily give up what they have taken in when squeezed a little by the next theorist. The "people" who "do not consider," and who "are destroyed for lack of knowledge," are as universal as the human race, and the persistence of this trait has not less weight than some others urged in proving that the race is one. They who live "to tell or to hear some new thing" are not dead yet, and do not all live in Athens.

But a doctrine is not to be condemned because it is new, or to receive unquestioning acceptance because it is old. The Ptolemaic system of astronomy was fully believed in for a score of centuries, and afterwards found to be fallacious; and we know not how many accepted theories of the present day will be swept away with the advancing floods of intellectual progress. The question of a true philosopher is not whether the doctrine is musty and discolored with age, or is young and untried as the new-born babe; but whether *it is true*.

A most important desideratum to an investigator is a disposition to see both and all sides of a question with equal candor. An unbiased mind, which searches *alone* for *truth*, is the only one qualified to investigate with success or safety. If one begins with preconceived opinions, he is almost sure to become a special pleader in favor of the notions he most desires to establish. With a theory to prove, especially if he has expressed it with any considerable positiveness, he must have virtue almost super-human to give equal weight to arguments for and against it. Men are naturally so averse to any intimation that *they* have ever made a mistake, or failed to see through and through a thing at first sight, that a change of views is, to many, a confession of weakness or ignorance. Owing to this prevailing weakness of human nature,—which is a far more serious malady than the fallibility it is designed to conceal,—it is extremely wise to withhold any positive expression of opinion upon a debatable or much debated question upon which one wishes to reach the highest truth. Of course, one must have a work-

ing *hypothesis*, and some theories to *test*; but this is far different from having a position to *maintain* at all hazards.

Another serious obstacle to the search for truth is that men are too apt to accept the "confident assertions and well-put arguments" of popular writers and speakers without inquiry, when these accord with the views they wish to believe. The merest charlatan has only to say his opinions are based upon those of some "distinguished investigator,"—whose name he is very careful not to mention,—to give his assertions the full weight, in the minds of many, of a naturalist or statesman, a theologian or philosopher, who has exhausted his subject in original and painstaking research. We have ample illustration of this sort of special pleading and of the suicidal popular craving for it, (without mentioning numerous others) in the criminal distortions of the teachings of both nature and Scripture in the interests of infidelity, and the hardly less criminal ignorance of these things in the interest of religion. It is sadly humiliating to see those whose professions would argue clearer discrimination, grasping at untenable theories because they are fancied to establish notions one wishes to maintain, or positions supposed to be essential. This state of things is largely due to the popular willingness to be imposed upon and the vicious cramming system of ordinary school instruction; both tending to the destruction of independent thought.

While this practice of running wildly after every new theory is pernicious in its effects upon the legitimate investigations of our times, the fact that great changes in sentiment and practice are yet to be looked for should not be ignored. There are, doubtless, phenomena continually exhibited all about us which we do not even perceive, much less understand, but which it is the office of independent thought to discover, investigate, and explain. That revolutions are yet to take place, the rotten foundations of our present political fabrics but too clearly indicate. Bickerings and jealousies in the church show that it must have yet other reformations. And the arbitrary laws of popular custom need to be completely revolutionized. Lack of the habit of observation, tenacious adhesion to party and precedent, selfishness, and fear of violating the exactions of society, are the obstacles here. Undue conservatism tends no less to lock the wheels of intellectual progress than excessive fanaticism.

The bull-dog method of convincing an audience or an individual is another fruitful source of evil. There are intellectual highwaymen who *assert* with such positiveness their unsubstantiated tenets,—as if annihilation, total and immediate, would be the price of non-acceptance,—that ordinary minds tacitly assent, on the principle that discretion is the better part of valor. They are simply overpowered, not convinced. When one in the form and fashion of a man, with commanding impudence thunders out, either in word or in substance, "you are wrong, sir, and I am right, and you are a fool if you don't admit it," I yield to him as I would a bandit with a loaded pistol at my head, and with very much the same feeling toward him. He has by brute force suppressed all expression of opinion from any who would not be as ill-mannered as himself; but has not forced from a thinking hearer the reserved right to hold views sustained by the

latter's own reason and judgment. Too many are, by these intellectual mastiffs, completely frightened out of all future claim of right to their own opinion, on the very erroneous supposition that what is so positively asserted must be true. On the contrary, the more carefully and honestly one has examined all phases of a much-disputed question, the more of truth does he see on both sides, and the more hesitancy he feels in positively pronouncing his convictions: whereas, he who has seen only one side is thoroughly convinced (like the negro judge, who could decide best before the arguments for the defense had confused him) that the case is so clear already that further argument is superfluous. So true is this that, perhaps, no better rule can be given for estimating the value of an author's statements on mooted topics than this: the weight of his opinion is in inverse ratio to the positiveness with which he asserts it.

The field in which a single individual can be an absolutely *original* investigator, is a very narrow one. No *one* can examine *all* the facts bearing upon any important subject of discussion. All are, therefore, compelled to take on trust, to a greater or less extent, the observations and often the interpretations of others. With the severest scrutiny and most scrupulous care, this is often hazardous and misleading. No two persons see exactly alike, even when both have sight and judgment in normal condition. Each observer sees a different rainbow, and even the two eyes of the same observer, as in a stereoscopic view, see different phases of the same object. Such physical defects as near-sightedness or color-blindness of which often the individual himself is not aware, may materially modify the appearance of things he has carefully examined. Moreover, one's powers of discrimination are liable, often unconsciously, to be warped by personal interest or by prevailing opinions and habits of thought, and, through ignorance of this fact, far too high an estimate may be placed upon the results attained by him. Again, with perfectly normal vision, and totally free from mental bias in any direction, one may fall far short of the soundest conclusions through *lack of training* in observation, comparison, and judgment. The conclusions of a novice should not be graded with those of a trained investigator. He may be possessed of equal powers by nature, but has not learned to use them with equal discrimination and effect. Nor does it follow, because one is an adept in a single line of effort, that he is equally trustworthy in every or in *any* other. The old truth, taught by Æsop, that nature does not confer every good upon one, is too often forgotten. An authority in theology, for instance, is not necessarily an expert in science or philosophy. That he is necessarily *not* an expert in these would, doubtless, from the nature of the case, be equally true. So, high official position, or even eminent success in certain directions, often carries with it, in the judgment of the masses, an authority far above its real value. Advancement in position or circumstances may be due to brass, selfishness, favoritism, or accident, and not to real worth.

These considerations and many others are too often overlooked or ignored in reaching conclusions. To weigh correctly the stated results of every investigator, it is necessary to have his personal equation, or error, as carefully deter-

mined and as clearly expressed as that of an astronomical observer; and to have all the helps and hindrances to his work, tending to modify his results, estimated with the same vigorous discrimination. Except, perhaps, in the line of mathematics, we have no *means* of doing this, because we have no fixed standard of comparison as in the heavenly bodies and in the direct proofs possible to mathematical reasoning. In other lines, the nearest to accuracy we can reach is in the careful balancing of probabilities. In this, too, the personal liabilities to error are involved, and thus the conclusions of erring men, even with equal honesty and candor, are necessarily subject to infinite variation.

Another difficulty in arriving at truth, growing out of our necessary dependence for data upon the researches and statements of others, is in the liability to miscomprehend the facts as stated. If an author's statements are written, by the simple oversight of a comma his words may convey a widely different meaning from that he intended. The mistake of a little girl who protested that there would be plenty of preserves to eat in heaven, because the catechism says, "He makes, preserves, and keeps them;" and the pessimist's quotation, "There is a divinity that shapes our ends rough, hew them how we will;" are not without a parallel in many a more profound research. When statements are taken from oral delivery, it is easy to fall into an error like that of the little girl who, on returning from Sunday School, asked her mother what kind of a bear a consecrated cross-eyed bear was. She had heard them sing, "The Consecrated Cross I'll Bear." Another, who had heard repeated the golden text: "Behold! a greater than Solomon is here," said on returning home that the text was, "Hold a grater to Solomon's ear." Men are often charged with statements which are equally foreign to their real sentiments. This may be due to no lack of honesty but to lack of good hearing or of discrimination.

In too many other cases, however, it is nothing but sheer dishonesty. Even men in high positions are not infrequently detected in garbling quotations from more original authorities, coloring their extracts to favor their own views and positions, when the real meaning of the author quoted is entirely different. Lorenzo Dow's text from the Bible, "Top-not come down," (Matt. 24, 17), for a sermon against the coal-hod bonnets of his day; the wag's rendition of Scripture, "The wicked flea, when no man pursueth but the righteous, is as bold as a lion," are not a whit further from the truth intended than many of these mutilated quotations.

It is not particularly assuring to one who wishes to keep a general run of the best thought and work of the age, and must take it largely at second-hand, to be engulfed in such a chaos of deception and contradiction as the following, which is not an imaginary case: One reads an article by a not unknown writer, setting forth views pleasing to the reader and such as he would gladly accept. He notes them as of peculiar interest. Coming to "editorial notes" in the same issue, he finds expressions of doubt as to their correctness. In a latter issue the reader is reassured by a rejoinder in which the criticised author maintains his position "without fear of successful contradiction" by a long array of instances, and fortifies it with copious quotations from the writings of known and trusted

ivestigators in that special field, and names many others who accept his conclusions "with very slight, if any, qualification." The disappointment of the student is bitter when, on further reading he finds that two independent critics lmost annihilate an authority upon which the first author had most largely depended for support in his position. This authority had inserted and omitted words in a direct quotation from a still earlier author which gave the latter's words an opposite meaning; and had given great weight to the views of another, imself "known to be very unreliable as an authority." In another publication, he student finds the original defendant further discomfited, and his own confusion increased, by reading that the paper of the defendant's main authority, while ubbed "very able" and "forcible" by one reviewer, is said by another to be "remarkable for its erroneous statements and its misapprehension of facts," and "still more remarkable when we consider its assumptions for what it does not ontain." Still another authority, quoted by both the defendant and his right-and man as of great weight, was shown by yet another critic to have retracted he very statement quoted and confessed he was misinformed. In view of the herent difficulties in the way of a satisfactory solution of the many deep questions which vex the thinking world, it is immensely important that these difficulties be not wantonly multiplied by parties who warp truth and insinuate error n dishonest attempts to establish their own positions.

GLASGOW, Mo., February, 1885.

BOOK NOTICES.

ORIGINAL RESEARCHES IN MINERALOGY AND CHEMISTRY: By J. Lawrence Smith, M. D. Octavo, pp. 630. Edited by J. B. Marvin, B. S., M. D., Louisville, Ky., 1884.

This handsome volume, as stated in the February number of the REVIEW, was prepared at the request of Mrs. Smith as a testimonial of her esteem and as a memorial book for presentation to Professor Smith's scientific friends and relatives. Dr. Marvin has devoted much well spent time to its preparation, and the publishers have put it forth in elegant and substantial form.

Professor Smith was essentially an original investigator, and, from his student ays to the end of his life, labored earnestly and diligently as a skilled explorer n the several fields of chemistry, mineralogy and physiology. He had hosts of riends among the learned scientists of this country and Europe, and received onors from nearly all of the scientific associations on both sides of the Atlantic. Besides the biographical sketch of his life by Dr. Marvin, prepared by request for he American Academy of Arts and Sciences of Boston, another was written for Year Book of the City of Charleston, S. C., by Middleton Michel, M. D., and

still a third for the National Academy of Sciences by the late Professor B. Silliman. In fact, one of the last literary labors of Professor Silliman was the preparation of this memoir to his old friend and colleague, and almost his last energies were given to directing the completion of the medal which is, through the liberality of Mrs. Smith, his devoted widow, to be presented to discoverers in the study of meteoric bodies as the "J. Lawrence Smith Medal."

Beginning life as a civil engineer, he devoted himself earnestly to acquiring a complete knowledge of his profession, but finding it not altogether to his taste he abandoned it and studied medicine, giving six years to it in the best schools of this country and Europe. Returning home at the age of twenty-six, he commenced lecturing in the medical college at Charleston. From that time forth he was a teacher; a portion of the time in the University of Virginia and afterwards in the University of Louisville. He was appointed at the age of twenty-eight, at the request of the Sultan of Turkey, to teach the agriculturalists of that country in cotton culture, and was subsequently made a government mining engineer by the Sultan, in which position he was so serviceable to that country that he was honored with numerous decorations and costly presents.

His researches in chemistry and mineralogy were published from time to time in *Silliman's Journal*, the *American Chemist*, *Cosmos*, the Proceedings of the American Association, etc., as well as in several of the principal French and German scientific periodicals of the day, and were regarded as valuable contributions to knowledge. His collection of meteorites is one of the most extensive in the world, and he was an acknowledged authority on this subject.

His original researches number about one hundred and fifty, while his lectures, addresses, scientific and secular papers amount to many more than this. Aside from his professional labors of all kinds, his life abounded in beneficent acts, and he was able to say at its close, "Life has been very sweet to me. It comforts me. How I pity those to whom memory brings no pleasure."

GEOLOGICAL EXCURSIONS, OR THE RUDIMENTS OF GEOLOGY FOR YOUNG LEARNERS: Alexander Winchell, LL. D. 12mo., pp. 234. Illustrated. S. C. Griggs & Co., Chicago, 1884. For sale by M. H. Dickinson, $1.50.

Of all of Dr. Winchell's works this simple book for children is likely to accomplish the most good, from the fact that it begins at the right place,—in virgin soil—so to speak; where there is nothing to be unlearned and where the good seed will take firm root and bring forth good fruit. The teaching of geology is usually postponed until "college days" and there the whole science is crowded into a few months at the rate of about two lectures a week and—at least in our own case—without specimens or practical field illustration. Every man remembers his youthful collections of "petrified wasps' nests," "funny stones," etc., and how easy it would have been to have crystallized his enthusiastic interest and admiration into actual practical knowledge at that time, whereas in most

instances he knows as little now as then of geology, notwithstanding his subsequent "course" in college.

Dr. Winchell, in this text-book takes the pupil in this impressible stage of life and by means of illustrations from the garden, the field, the gravel bank, the laboratory, in the marble yard, by the water side, in the gorge, at the rocky ledge, etc., familiarizes even the youngest pupil with the various kinds of rocks, gravels, and clays of, which the crust of the earth is formed. He then takes excursions to the White Mountains to examine the Eozoic rocks; to the Upper Mississippi to examine the Cambrian formation; to Niagara Falls to learn the history of the Silurian; to Mackinac for the Devonian; to Burlington, Iowa, for the Lower Carboniferous; to Selma, Alabama, for the Mesozoic rocks; to Claiborne, Alabama, for the Tertiary formations, to the river valleys for the Quartenary; to Switzerland for Glaciers, and finally, through the Ages for a comprehensive history of the plants and animals of the past.

Much use is also made of maps in training the learner, objectively, to proper conceptions of superposition, succession, continuity and other phenomena of the stratified rocks.

At the end of each chapter "Exercises," consisting of questions upon the previous statements and subjects growing out of them, are found, which is an admirable feature of the work, since it tends to keep the pupil thinking for himself and not permitting him to depend solely upon his text-book.

As a text-book for beginners in the study of Geology—and they cannot begin much too early—this is the best work we have ever seen, and the advantage of it is that any teacher can teach it without previous knowledge of the subject.

CONDITIONS OF MENTAL DEVELOPMENT, AND OTHER ESSAYS: By Wm. Kingdom Clifford, F.R.S. Price 15 cents, post-free. J. Fitzgerald, New York, 1885.

This volume forms No. 65 of the *Library of Popular Science*. Besides the essay on Mental Development, it contains three other essays by the same distinguished author, namely, "The Aims and Instruments of Scientific Thought;" "Atoms;" and "The First and Last Catastrophe." Prof. Clifford stood in the foremost rank of scientific philosophers, and the essays here published are among his most elaborate productions. They are now for the first time offered at such a price as to bring them within the reach of all.

SCHOOL KEEPING. HOW TO DO IT: By Hiram Orcutt, LL. D. 16mo., pp. 248. New England Publishing Co., Boston, 1885. For sale by M. H. Dickinson; Cloth $1.00.

The design of Dr. Orcutt in publishing this work is to aid and encourage those who need and would profit by the experience of others and to awaken an interest among other classes as well as teachers in the subjects treated.

L. Shepard, A. M. Octavo, p
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most flattering terms, and commends this book to the teachers of the country as worthy of their adoption as a text-book in their schools.

It is divided into three parts, viz: Matters of Taste, under which head he treats of principles of art, principles of taste, floral taste, etc. Secondly, Matters of Art, such as the art of design, ornamental gardening as an art of design, the study of nature, first principles of association, study in landscape gardening, etc. Thirdly, Matters of Fact, under which he discusses correct judgment, home gounds, public improvements, grounds of institutions of education, and the burying ground.

The work is written in graceful style and the subject is presented logically and impressively. No one can read it without being convinced that Mr. Kern is master of the subject and that his thoughts are worthy of careful attention and general adoption.

OTHER PUBLICATIONS RECEIVED.

Meteorology of the Mountains and Plains of North America, an address before the Cattle-Growers' Convention at St. Louis, by Silas Bent, St. Louis, Mo.; E. P. Studley & Co., printers. *Annals of Mathematics*, edited by Ormond Stone and Wm. M. Thornton, Office of publication University of Virginia, Vol. I, No. 4, Charlottesville, Va. Trumbull, Reynolds & Allen's Annual for 1885, Kansas City, Mo. *Journal of New York Microscopical Society*, edited by Benjamin Braman, Vol. I, No. 1, New York; $1.00 per year. *Journal of Mycology*, edited by W. A. Kellerman, Ph.D., and assisted by J. B. Ellis and B. M. Everhart, Manhattan, Kansas, January, 1885, Vol. I, No. 1; $1.00 per year, 15c. a number. Supplemental report of the Railroad Commission of Tennessee, by John H. Savage, Nashville, Tenn., Albert B. Tavel, printer. *The Iowa Historical Record*, published by State Historical Society at Iowa City, January, 1885, Vol. I, No. 1. Water Purification for Steam Boilers and Laundry Purposes, William Tweeddale, Topeka, Kansas. *The Canadian Science Monthly*, No 1, Vol. III, Wolfville, N. S. *The Humboldt Library*, No. 65, price 15c.; Conditions of Mental Development and other essays, by Wm. K. Clifford, J. Fitzgerald, Publisher, N. Y. United States Consular Reports: Labor in Europe, Letter from the Secretary of State; Washington Government Printing Office, 1885. Circulars of Information of the Bureau of Education, No. 7, 1885: Aims and Methods of the Teaching of Physics, by Professor Charles K. Mead, Washington, D. C. Prix-Courant, d' une Choix de Graines, spicialement recommandables pour, 1885, Monsieur le Director La Compagnie Continentale d' Horticulture Gand (Belgique). Columbus, Ohio: Its Commerce, Industries and Resources of 1885, published by the Columbus Board of Trade. Early Migrations, Arctic Shifts and Ocean Currents, by Charles Wolcott Brooks, San Francisco, California, 1884. *The Auk*, Vol. II, No. 1, January, 1885, Boston, Mass., Estes & Laureat; $3.00 a year, 75c. a number; edited by J. A. Allen, Cambridge, Mass. Department of Interior,

Building for the Children in the South, Washington Government Printing Office.
Report for the year 1883–4, presented by Board of Managers of Observatory to the President and Fellows of Yale College.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

PRODUCTION OF INODOROUS COAL OIL.—This process especially contemplates the treatment of refined oil, the object being to thoroughly remove all traces of the original odor from the kerosene.

To this end the invention consists in employing induced currents of air as a vehicle for carrying away a portion of the odorous impurities in the liquid, and in neutralizing or destroying a further portion of such impurities by the action of sulphuric ether, and while changing the color of the product, in neutralizing the remaining impurities by the addition of a coloring compound and a mixture for imparting fragrance.

In the procedure of carrying out the invention the kerosene is located in a suitable tank where it is acted upon and thoroughly agitated for the period of one hour, or thereabouts, by currents of ordinary atmosphere induced by any suitable air-pumping apparatus connected to the said tank.

Then a certain quantity of sulphuric ether (about one drachm to each gallon) is added to the product while in the tank, and thoroughly incorporated therewith by the action of the air-currents which are again 'supplied as before named and continued for the period of about ten minutes.

The color of the product so formed may now be manipulated to any desired shade by adding to each fifty gallons a mixture consisting of one ounce of aniline (any color) and twelve ounces of linseed oil.

The addition of this coloring mixture not only changes the color of the product but a portion of the remaining impurities are neutralized thereby.

To still further and completely destroy any remaining trace of odorous impurities that may adhere to the product, and, at the same time to impart a pleasant fragrance thereto, a mixture consisting of one ounce of oil of almonds (or any other fragrant extract oil,) and one ounce of sulphuric ether is added to each fifty gallons of product.

The above described process has been patented by Mr. Leon Blumenthal, of Kansas City.

A TUBULAR WELL.—The object of this invention is to provide tube-

wells with such improved water-lifting devices as will render their construction and repair more certain of accomplishment, and their operation comparatively more reliable than heretofore.

It has been found in practice that, owing to the nature of the ground through which the greater number of tube-wells are bored, the cylinder corrodes so as to be within a short time almost or entirely unfit for service.

In order to remedy this defect it is proposed to galvanize the cylinder both internally and upon its outer surface.

Heretofore much difficulty was had in driving check-valves to their seat at the lower extremity of the cylinder or driving-barrel. As there was practically nothing connected to them that would keep them in a vertical line with the cylinder, they would, as it were, attempt to turn end for end, and in many cases would come to and be left upon their bearing in an oblique position.

A check-valve under such circumstances could not fully accomplish the object which its name implies. An improved check-tube is closely encircled near its lower end by a turned ring which has a diameter corresponding to the bore of cylinder.

When the check-tube is being driven to place the drill-rod is attached to its upper end and a rubber packing-ring having a plain outer surface, guides the upper end, and the turned ring holds the lower end in a central position.

The said packing-ring has a flaring internal surface, and it is expanded by a correspondingly tapered cone upon the check-tube. Each of these parts is constructed with smooth surfaces for reasons explained further on.

The check-tube can only be driven downwardly until the coned surface comes in contact with a beveled seat flared from the internal diameter of the turned ring at its upper edge.

Heretofore, owing to the absence of such a seat to limit its movement, the check-tube has been driven so far within the packing-ring that the latter would interfere with the perfect working of the valve, and the packing-ring (usually rectangular in cross-section) would be compressed until when required its removal would be very difficult if not impossible.

The smooth surfaces of the improved cone and the comparatively small body of rubber forming the packing-ring render the withdrawal of the check-tube quite an easy matter. When the check-tube has been fully driven to place, the lower edge of the packing-ring is in contact with the upper edge of the turned ring.

An internally threaded thimble is attached to the lower extremity of the check-tube and prevents the same from being drawn upwardly without carrying with it the turned ring. This latter is secured internally at its lower end forming a concentric shoulder which is engaged by the upper edge of the thimble.

The lower edge of the turned ring or follower rests upon the top edge of the sand-point coupling. This coupling has an external diameter corresponding to the cylinder.bore and its lower edge rests upon a concentric shoulder projecting

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... CANE AND SUGAR ASSOCIATION.

... KANSAS UNIVERSITY.

... Association, held in Topeka on Febru... the passage of the bill now pendin... cane industry by the payment of ... sugars above a certain grade made in th... for the sugar industry in Kans... canes in Silo. Th... Analysis fr... diminished but slightly, while... that by thus keep... be doubled. A me... by Mr. A. A. Denton. ... methods of extracting th... the available sugar is obtain

utilize it as a source of glucose. Prof. Bailey read a paper upon the relative values of different sugars. From his experiments glucose has six-tenths the sweetening power of cane sugar. Prof. Scoville discussed the early history of the beet sugar industry, and drew important lessons of encouragement for Kansas cane growers. Prof. Swenson, also a superintendent of sugar works in the State, reviewed the reverses and successes of the business, and predicted that it would prove eventually a financial success. Unfortunately the recent fall in the price of sugar had left no margin for profits; they were in a much better position to make good cheap sugar than a year ago.

EDITORIAL NOTES.

THE severity of the past winter at this point may be seen by reference to the following table, showing the number of days in each month when the mercury reached zero, or below:

1884.		7 A. M.	2 P. M.	10 P. M.
Dec.	22	-2	5	5
"	24	-5	0	-2
"	25	-3	7	5
"	31	1	7	0
1885.				
Jan.	1	-8	5	3
"	2		15	20
"	16	-1	0	-5
"	17	-10	5	6
"	18	-1	5	2
"	19	-3	4	3
"	20	-3	16	10
"	21	-3	-2	-6
"	22	-8	13	20
Feb.	9	7	4	-7
"	10	-16	-7	-1
"	16	-10	7	8
"	18	-2	14	13
"	20	-7	9	9

S. B. HILL, of Stockton, N. J., writes: "I am glad you continued to send the REVIEW for I think it the best periodical of the kind that I know of. I inclose $2.50 to pay for it another year."

MR. JOHN P. JONES, the archæologist, writes Feb. 10th, "Enclosed find $2.50 for the REVIEW. Glad you keep it going. I take most of the journals published in the United States of a kindred nature and do not find any that affords more satisfactory reading than yours.

DR. D. G. BRINTON, of Philadelphia, has in press the fifth volume of his series of "Aboriginal American Literature," entitled "The Lenâpé and their Legends." It will present the full original text and all the symbols or pictographs, 184 in number, of *Walum Olum*, or Red Score of the Delawares and has never been published before. Cloth, $3.00.

THE accomplished Librarian of Congress, A. R. Spofford, asks for back numbers of the REVIEW that he may have the volumes bound for preservation in that library.

THE State Normal School of Kansas, at Emporia, was founded in 1865. Its endowment fund is $182,331.40; annual income about $16,500. Total enrollment in 1878-9, 80. Total enrollment in 1883-4, 534. The total enrollment in 1884-5 will be much larger. It is strictly a Teachers' Training School, and offers excellent facilities for special preparation for the active duties of the profession.

PROF. C. F. CHANDLER, of the School of Mines, Columbia College, New York City, editor of *The Photographic Bulletin*, which

commenced a new series with January, 1885, proposes to make it the organ for the interchange of ideas among scientific men and others interested in photography on the subject of photographing in natural colors. He desires correspondence on this subject, reports of phenomena that may have come under the observation of artists and others in this connection and suggestions as to the direction in which investigations should be pushed

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from* 15 *to* 20 *per cent off the retail price.*

WE find the *Atlantic Monthly* for March an unusually spirited number. Dr. Holmes definitely opens his "New Portfolio," which is exceedingly engaging. Beside the three serials by Mrs. Oliphant, Miss Jewett, and Mr. Craddock, there are several papers which are of value to thoughftul readers. The chief of these is a sketch by Clara Barnes Martin, called "The Mother of Turgeneff," which gives a strikingly vivid but not altogether pleasing picture of Russian home-life fifty years ago. Two scholarly articles, "Time in Shakespeare's Comedies," by Henry A. Clapp, and "The Consolidation of the Colonies," by Brooks Adams, an almost painfully realistic story by Bishop, called "The Brown-Stone Boy," and a delightful Mexican travel paper, with the grateful title of "A Plunge into Summer," by Sylvester Baxter, complete the longer articles of the number. The usual careful book reviews and short notices, together with the Contributors' Club close this attractive issue. Houghton, Mifflin & Co., Boston.

OUR former references to the high character of *Education* as an able educational magazine are fully sustained by its January-February number. Supt. Long, of St. Louis, discusses "Intellectual Training in Normal Schools," and Prest. Hunter, of the New York City Normal School, the "Necessity and Growth of Normal Schools." Prof. Anderson, of Aberdeen, Scotland, writes of "The Æsthetic Element in Education," and Mrs. Hopkins treats of "The Memory Faculty," in her course in Psychology. Prest. Bicknell's Annual Address before the National Educational Association at Madison, appears in full. Other articles are "The Lost Atlantis," by Mrs. Knight; "Quintilian's Educational Theory," and Foreign Notes. This number is embellished by a steel engraving of Louis Prang, the celebrated art publisher of Boston.

This magazine should be read by all thoughtful teachers and parents, as it embodies the best literature of the teaching profession. Price $4.00; single copies, 75 cents.

WHEN a new drama has proved successful, it is customary for the audience to call the author before the curtain. They have a curiosity to see what sort of man it is that created the play that has amused and instructed them. There is something very much like this in regard to our great newspapers; their editorial utterances are all anonymous, but there is generally a tradition of some half-shadowy personage who has established the journal, given it its character, and constantly directs it; and the public like to have him come before the curtain now and them, to address them in his own person. This Murat Halstead, of the Cincinnati *Commercial Gazette*, has done in the March number of the *North American Review*, to which he contributes an article on "The Revival of Sectionalism." In the same number, Archdeacon Farrar presents his views on "Future Retribution," and Prof. N. K. Davis discusses "The Moral Aspects of Vivisection" in a way that brings together briefly nearly everything that any person of note has said on the subject. Max Müller describes the astonishing ideas of the Buddhists on the subject of Charity, and George John Romanes opens up a great subject with an article on "Mind in Men and Animals." The other articles are one by President Gilman on Titles (chiefly scholastic), one by Judge John A. Jameson on "Speculation in Politics," and one by John W. Johnston on "Railway Land-Grants."

KANSAS CITY

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A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

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PHYSIOLOGY.

THE NEW PHRENOLOGY.[1]

J. B. BROWNING, M. D., KANSAS CITY, MO.

It is the fate of humanity to do things in almost every possible wrong way before it hits upon the right one. Whether this arises from the fact that knowledge is something too precious to be lightly entrusted to man, or is something so indifferent that its possession will make little difference with the final result, is a question that we are not yet in position to determine. It is certain that in the natural order of things, by which knowledge is placed as a premium on effort, more stress is placed upon the effort than upon the acquisition. And the more important the knowledge to be acquired, the more does it seem to be beyond our reach. To know one's self has been considered in all ages the climax of human wisdom; and yet to know one's self has been the despair of the ages. The effort, like all others, has been made in the wrong direction and necessarily so. Suppose man placed in the center of the universe, in the center of a sphere whose boundaries are ever increasing outward, and he is to search through this sphere for a law or a fact whose existence is only inferred; there are a million chances then that he will look in a thousand wrong ways first. The chances are still more against him when he has to investigate himself, for here, besides finding the law on which to string his beads of fact, he must investigate the nature of knowledge

1 Read before the Kansas City Academy of Science, February 22, 1885.

itself. From within outward we go by-paths already formed for us. We use ourselves as self-registering yard-sticks, and the skull is a cup that contains our measure of the universe. The distance of a star is so many lengths of hand, or foot, or arm; the weight of a body is so many units of muscular effort. These measurements and weight preserved for us and rendered automatic by the continuity of the race form the bulk of our knowledge. The law by which our experience is marked upon our children, the fact that they look upon the world with eyes black or blue, because our own eyes are black or blue, and walk erect or bent by the weight of ancestral sins, this is what makes our knowledge cumulative and what it is. We must look upon humanity as a tree, and man as its blossom and fruit. Every blossom that falls scars the tree and modifies the trunk, and yet the tree grows on; and that explains to us the poet's lament over a nature

> So careless of the single man,
> So careful of the race.

This kind of knowledge, however, when applied to man, does not give results by any means so satisfactory as we could wish. It can give us a knowledge of the relations of man to society or to individuals, but we must know more than that if possible. We must know if possible how these weighings and measurings are projected into consciousness, their processes recorded and other things inferred from them. Consciousness, the little mirror held up to reason and to nature, must look at herself in her own glass. But how, when she throws no shadow? Mind, the infinitesimal piece of the infinite, which we say sits somewhere within, controlling the brain and nourishing it with its shadow, must be made tangible. That is the task. Let us see how we are progressing towards its accomplishment. If we should sit down and watch the action of some new complicated machine, and guess at the peculiar arrangement of wheels and levers within from the work that it accomplishes, certain gross results might indeed be arrived at. We might be able to calculate that another machine of a definite size would lift a certain definite amount of material, or would be able to displace a certain amount of matter. But our knowledge of its effective workings would not be such as would be required to repair it, or give us the full control of its energies. And yet this is identically the process that philosophers and scientific men have applied to man. They have set themselves to work to watch him upon the outside. They have seen that he thinks and have analyzed his thoughts so far as they appear in action, dividing them up into reason, judgment, memory, etc. This is as far as introspective philosophy or metaphysics can go.

Now I do not intend to say that the results thus obtained are worthless. They have a certain value, corresponding with our ideas, or, we might say with more justice that your ideas have been modeled upon them. Such terms as memory, imagination, etc., run through all the mazes of expression and have become woven into the fabric of human speech. With them as a basis our knowledge of mind became crystallized, became pseudo-scientific. Men reasoned; the mind builds the brain for its temple, expands it and contracts it to meet its wants. If

then, the person shows great powers of memory he must have a special organ somewhere in the brain whose prominence will be marked upon the skull; if he has great powers of expression his skull must be pushed out somewhere so as to give the brain room in that direction. A man with certain prominences on his head will steal or be a murderer, another with certain other prominences will be a poet or a musician. Seventy-five years ago Gall and Spurzheim took up this idea, amplified it and laid the foundations of the so-called science of phrenology. It is not my intention to discuss this very much. While we may say that as a general thing a man's character corresponds to his outward shape, we are still very much in doubt how much strength of mind is dependent upon size of brain, and we are by no means warranted in saying that because there is a depression in a man's skull at a certain point, there is a corresponding vacuity in his mind. A wit of our generation, who combines a knowledge of anatomy with a rare talent for poetry, has said, that we might as well try to tell the amount of money in an iron safe by feeling of the knobs upon the outside, as try to tell the amount of sense a man has by feeling upon the outside of his skull. This also is not entirely true, for while the safe might be empty, the skull being to some extent moulded by the brain and corresponding with the rest of the man, would show us several things. From its height we might judge somewhat of the person's stature; from its thickness and the size of its prominences, something of his muscular strength; perhaps from its apparent age and size we could tell that the person using it had had intellect enough to perform the ordinary functions of life, but to make a picture of his intellectual capacity would be beyond our power. Given a fossil bone and a naturalist can reconstruct some grotesque monster that sprawled and splashed through the prehistoric ages, confounding our theories of geology. He can tell sometimes whether it would be a reptile or a mammal; can make a rational guess as to whether its skin would be thick or thin and what its habits of life would be. This is a legitimate use of the scientific imagination, or more strictly perhaps of scientific induction. Given the bone of a man he could build up a symmetrical man, but the variations produced by civilization would render his restoration uncertain. He would have nothing to guide him as to whether the hair was light or dark, as to whether the man was civilized or barbarous, and these are all important factors in determining the grade of intelligence. For certainly no one will deny that blue eyes look upon the world differently from black ones, and that a thick skinned man is less tormented by the slings and arrows of outrageous fortune than one whose skin is thin.

When it comes to physiognomy much more can be told, though how much more is a fair matter for question. Certainly a man's soul should shine forth in his face and in his general appearance, and yet here there are some things that we do not understand. The big Roman nose led the Roman armies to the dominion of half the world, and yet the big Roman nose, the nose of Antony and Augustus, arches to-day the faces of innumerable Italian beggars and organ-grinders. Go to-day and sit down among the ruins of Rome and a man as stately as a Roman senator, or a woman as determined as Cornelia, the mother of the

Gracchi, will come to you and hold out the hand for alms. The mildest mannered man I ever knew, a man who I think would not knowingly harm man or beast, carried through life the face of a hawk. One of the most determined men I ever knew had a nose as pug as the variest child of fickleness. Yet reasoning a priori, we would expect that inasmuch as the muscles of the face are used to express the passions, the frequency of their action would cause a muscular growth by which the predominant passion would become marked there permanently. But some faces seem to be masks or puzzles; some faces like Talleyrand's words are made to conceal thoughts and vices. But in this connection some facts show that the fault may be more in the reading than in the face. The main feature of the mesmeric state is that the subject for the time being loses his will power and becomes a human automaton, obeying outward impressions. If, when in this state, you tell him that he cannot bend his arm, he cannot do it; if you tell him that there is fruit growing upon the icy street, the mere suggestion will cause him to see it, and make endeavors to reach it. Place his head then in the position denoting pride, and he will immediately display the feeling; contort his face until the muscles convey the impression of anger and he will show mental signs of rage. The mere action of the muscles upon the brain has suggested these feelings to the nerve-centers in the inverse order from that in which they are usually presented. Position then, and feature, must be intimately associated with the manifestation of character, and if we cannot read it aright the fault must be our own.

But there is something more in knowing humanity than the mere ability to read individual character. If phrenology had really given us what it pretended, a key by which every man's character might be read and his actions in any particular case predicted, the central features of the problem would still remain unanswered. We should be very little nearer to knowing man in the abstract—to knowing how the brain uses itself, as a measure or a weight. We are still upon the outside, watching the effects produced by the machine. Spurzheim, it is true, made an important step in dissecting the brain when he divided it from below upward, showing that the white fibrous matter passed up from the periphery of the body and ended in the grey matter of the cortex, but there the matter ended with him. Whether he thought that sufficient to prove the truth of his teaching or not I can not say. But like every new discovery it was simply a door opened by which a hundred doubts rushed in.

After his time a strange activity awoke in scientific circles. Men interested in knowing what life was, men who could think and who tried to lay aside their prejudices, began to question nature by experiment. Not one man alone, but a hundred applied the interrogation, striving to arrive at the truth from different directions, and to counteract one prejudice by another. In the course of these experiments they learned some things that have materially changed our views of the workings of the mind and the division of its faculties. And first to understand these experiments we must start in with the postulate that it is impossible for us to know anything about mind except with the brain as a basis. As

long as man remains man he lives and acts and cerebrates through continued change in his nervous tissue. Brain and muscle are alike in their demands upon the blood for nutrition, and the exercise of their powers is a continued death in life. If mind can exist without brain we so far have been unable to discover it. But this is not to deny that there is a power back of mind which is mightier than it is, and which differs from it in quality and quantity. It is merely to say that mind as we know it is not an ultimate, it is the result of certain conditions. How do these conditions produce in us the various processes by which we know? The first thing to do then was to find out the functions of the various nerve tracts. The brain looked at through a microscope was worse than a labyrinth, worse than a tropical jungle. There were cells upon cells of grey matter with numerous polypus-like branches extending off in every direction, connected here and there by fibres, hundreds of thousands in number, and giving no hint of what their office might be. These brain-cells, looked at roughly upon the outside, seemed rolled up together in convolutions, separated from each other by deep sulci. A fair comparison would be that the nerve tissue was arranged like a cauliflower in blossom. These convolutions were nearly uniform in position and arrangement in all brains, but from this nothing could be inferred. So very inconclusive, indeed, were the first experiments, that Flourens, the Frenchman, promulgated the idea that the mind acted as a whole, that the removal of any part of the hemispheres affects all the cerebral functions alike, and that therefore every part of the brain has the same functions. This opinion held almost complete sway in the scientific world for a quarter of a century, and even now is believed in some very respectable quarters. Its incorrectness was first shown by the observations of Broca upon disturbances of speech caused by injury or disease in a limited portion of the frontal lobes. This was followed up by the observations of Meynart of Vienna, who from anatomical reasons and from post mortem observations concluded that the fore part of the brain possessed motor and the posterior sensory functions. After this the animal becomes our teacher. Science is a religion that demands its martyrs. The brains of innumerable dogs, rabbits, and monkeys were interrogated with knife and battery, and the results obtained were compared with those already known. Ferrier of England laid bare the brain of a dog and placed the poles of his battery upon certain nerve centers. When one portion of the brain was irritated he noticed that the dog would draw up the corners of his mouth, show his teeth and snarl. When another was touched the pupils of the eye would expand. When still another, the animal would raise his head as if on the lookout for game. These experiments must be repeated and verified a thousand times before they could be received and believed by the scientific world.

Men realized that facts are like diamonds cut with facets. If the answer to a problem is true, there must be many ways of reaching it. And especially must this be the case when we are dealing with things so intricate as the nervous system, where facts must be to a great extent inferred. If these were really localized centers, animals or men would be deprived of the power conferred by these

centers when they were taken away. So they proceeded to slice away certain portions of the brain, or wash them away through holes in the cranium, and then noticed the results that followed. Not content with this they took advantage of the law of nerve degeneration and produced this degeneration artificially. Waller, an Englishman, had shown that nerve tracts when separated from their centers degenerate in the direction in which they convey impulses. Those conveying impulses outward then, as the nerves of motion, would degenerate outward—the sensory nerves inward. Taking this as a starting point, Von Gladden, of Munich, enucleated the eye balls and removed various portions of the brain from new born animals, then allowed them to grow up and killed them to trace the portion of brain that had atrophied. From the results of all these experiments combined it has become pretty definitely settled in the scientific world that certain portions of the brain have functions different from those of other parts. Inasmuch as the brains of animals differ in their arrangement from those of men, these results must be compared with others and corrected before the final conclusion was drawn, and then it was found out that the brain is to a certain extent a map of the man. We now know with a sufficient degree of certainty that the forepart of the brain is taken up by the centers for muscular action. First comes the centers for the muscle that raises the head; then that for the muscles of the arm next that for the muscles of the mouth and throat; then those for the lower extremity. After this, in the back part of the brain, in the occipital and temporal portion, as we call it, come the centers for sight, hearing, smell, etc. This, of course, gives us a new topography, and so far is, perhaps, an improvement on what Gall and Spurzheim furnished us, because it conforms more to the nature of facts. But it does not give us a much nearer knowledge of the action of mind. If it stopped there, it would be of interest to the physician and the man of science, but would not much concern the philosopher. Like a new land discovered, it would be so much added to the habitable globe, but would give us no nearer insight into the principles that rule the world.

Certain new things, however, have been added that materially change our ideas of cerebral processes, and show us that terms which we before used to signify the ultimates of our mental analysis are capable of still further resolution. No brain action, be it ideation, or simple reception, is simple, but all is complex in the highest degree Back of it all—back of our consciousness—looms the gigantic form of our unconsciousness. We feel. What does that imply? Something more than the mere contact of the hand with a body. It implies a change in the equilibrium of nerve structure, extending from the skin up through the different ganglia of the spinal cord to the cortex of the brain where a very complicated interpretation goes on. That is the unconscious part in us. Whether this is in the nature of a vibration, or a change in polarity like that by which the -dle follows the pole, we cannot tell. How the nerve fibers, the little lines of -raphic protoplasm, communicate with the hundred cortical cells whose united -n is necessary for this interpretation we cannot tell. Only when the inter-tation is completed does it come up to our consciousness, arouse it as if by a

punch in the ribs, and say: Here is something to know. So when we move a muscle it seems a very simple thing to do. But of how much of the moving mechanism are we conscious? We may be conscious of the motive that causes us to move it. We may to a certain extent perceive the contraction of muscular fiber. But we are not conscious of the co-ordination of brain cells, and the impulse sent out along the nerves to the muscles. And this unconsciousness extends up to psychic circles, to the higher forms of mental action. If there are cells in the brain specially set apart for thought, they cannot be distinguished by the microscope or by any process that we are masters of. We cannot differentiate their modes of action from that of cells we know, and as the elaboration of thought results in tissue waste as rapidly as the use of muscle, we must suppose that it is accomplished by a similar cell co-ordination. This also belongs to the field of the unconscious. In fact it is the most unconscious and unruly part of us. It is a common saying, truer than we think, that we cannot control our thoughts. The muscular effort we can control. It comes when we require it, and it is always strength; but with our thoughts it is like Glendower and the spirits.

"I can call spirits from the vasty deep."

"Why, so can I or so can any man. But will they come when you do call for them?"

We set down to meditate and they come to us, full grown, like Minerva from the brain of Jove. I do not wonder that some persons think they are inspired. All of us are inspired in this way, and the grandest thoughts of the human brain have this mechanism of inspiration in the same manner as the humblest. In some cases of disease this unconscious action reaches a point which the senses are unable to correct. Hallucinations then appear projecting themselves into the various fields of cognition. Persons hear voices, see visions, and the inspiration runs riot, becoming insanity. From this unconscious mechanism other things that have puzzled us take their explanation. How do we get our knowledge of time? It is a mental blank, and it eludes our analysis. We can only understand it as a succession of something occurring at regular intervals. In our waking state we cannot guess at these intervals with any degree of exactness. Rip VanWinkle, grown old in his twenty years' sleep, could not convince himself that he had slept more than a single night. We can form no mental conception of time. And yet if we retire at night with the firm resolve to wake at a certain hour, we find that after a few trials we can do it. How can we explain it? In no way, rationally. And yet the fact that Rip VanWinkle grew old and gray while he slept explains the matter for us. The unconscious mechanism within is our time-keeper, keeping its record in heart beats and in its own growth and decay. So many particles of matter taken on, so many others cast off, one taking the place of the other seemingly, yet not doing it exactly, until by and by the power of taking on is exhausted and the circle of existence is complete. That is the history of the brain cell as it is of all other cells. Next, these investigations have widened out our ideas of the complexity of sensations and have given us the means of resolving them still further. Memory, we now know, is no special

localized organ or power. Phrenologists placed this, if I remember rightly, somewhere in the middle of the forehead where the two tables of the skull separate and leave a cavity between them called the frontal sinus. Here of all places throughout its extent the form of the brain corresponds least with that of the skull. In fact, as far as I can judge, the greater thê prominence of the skull on the outside the greater is the depression inside. Yet here they located the storehouse, the arsenal of the mind, and judged of its size by the outward protuberance. Well, investigation has shown us some curious things in regard to memory. We can no longer look upon it as a place in the brain where facts are pigeon holed, or a picture gallery where countless images are hung up to be rummaged over when the mind requires to look at them. The probabilities are great that memory is a general property of nervous tissue, and perhaps of other tissues still.

Munk and Lucianini, experimenting upon the localization of the various senses, found that when certain portions of grey matter were sliced away, animals failed to recognize objects. In this condition an animal may see an article of food and yet will not eat it until he has subjected it to touch and smell. He may hear sounds and yet will not know their meaning. This they have called psychical blindness or deafness. If a dog thus made blind be led into a garden where it has been accustomed to stay, it proceeds straight along the paths, successfully avoiding the contact of hedges, walls and other fixed obstacles which it comes across. The animal is not blind; he has simply lost his memory of things seen. If a dog thus made deaf be called he will turn his head and show signs of hearing, but he will not follow the voice of his master. He is not deaf. He has simply lost his memory of sound. Immediately this commences to be replaced, not by the supplying of new tissues, but by the neighboring tissues taking on the mode of action of the old. This same phenomenon sometimes occurs in man through disease. In one recorded case the patient could see a chair that had been placed in his way, but only avoided it after having once stumbled over it. Fire brought close to his eye did not frighten him. He touched it to find out what it was, and only then avoided it. He could see wine, but seemed not to know its use until it was touched to his lips. Cases of word deafness are more common, cases in which the person afflicted does not recognize the meaning of a word when he hears it. What is the interpretation in these cases? That the store of sensory experience has been destroyed? In a certain sense, yes; in another, no. The brain tract used for that purpose had simply become disabled, but another brain tract showed itself capable of taking up these experiences and elaborating them. From these and other things certain philosophers have formulated the idea that memory is simply the faculty that nerve tissue has to persist in the same direction of arrangement for its particles. Every impression produces, we will say, a rearrangement, marked in its structure, and when recollection comes to us it is simply a return to this rearrangement. There are many things to substantiate this. The older the impression produced the more deeply does it be-
arred upon the organism. The newer the impression the less firmly is it

fixed, the less often has it been adverted to. So in the phenomena of mental decay we have the newer impressions dying out first, because they are less firmly organized into the system.

The old man in his second childhood goes back literally to his first childhood, and his memory is that of the child. It is sometimes to be commented upon that we have not found any tracts in the brain of higher significance than the sensory tracts. One or two cases on record of wounds in different parts of the brain show interference with the will, but it is still somewhat doubtful where these parts of the brain are located. The power of speech should be connected with the power of thought, for it is almost impossible for us to think without language. Words are the coins of thought, and there is no barter that can take their place. Somewhere back in the occipital cortex is supposed to be the center of speech. Somewhere perhaps in the field where all the senses seem to meet and overlap each other. We cannot locate this so well as many other things, because in animals on which our experiments are carried on the field of language is very small. Many phenomena of disease, too, show that a great many of our psychic processes are carried on in connection with the senses. In a person suffering from brain disease, it was noted that when he tried to grasp an object in the hand of the physician, he moved his head from side to side, then seized the physician's arm and followed it nntil he reached the hand. He could not count objects without touching them. Often in attempting to touch objects he reached beyond them. In counting small objects he often overlooked them, or counted the same ones repeatedly. At a later period he could recognize small letters, but if they were combined to form a word he could neither read the word nor point out the separate letters. There was simply a hemorrhage in the brain interfering with the centres of sight, and yet it interfered with the mental conceptions of space, position and number. Hundreds of similar examples might be brought forward if it were necessary, but enough has been said. We are not yet done with such investigations. Perhaps we never shall be. We know from experience that every avenue towards truth is closed by a question, by a doubt. We are a little nearer to the solution of some things. What is our consciousness? The elaborated result of cell action, the foam that crests the wave of our unconsciousness. What is memory? Persistence of arrangement. What is reason, judgment, etc.? Elaborations of sensory memories and impulses. That is as far as we have gone, and it is at least a different view of affairs from that which held the world so long.

WHERE DOES CONSCIOUSNESS RESIDE?

We have outlined the structure of the cerebro-spinal system, and have stated what may fairly be set down as established concerning the functions of this system up to the cerebral hemispheres. With respect to the presence of consciousness in the parts already examined, it is plain that opinions radically differ. Some maintain that consciousness is not manifested apart from the action of the cere-

brum, that all nerve-activities below this organ are reflex, their only distinctions being in the matter of complexity. Others are eqully positive that consciousness accompanies all nerve-actions, while others still assert that certain organs below the cerebrum—viz.: the pons Varolii, cerebellum, optic lobes—form a sensorium commune where consciousness in some form appears. It is my opinion that this last conclusion has not, as yet, been established or refuted. I regard it as the most rational of the three in the present state of knowledge. If we accept it, we must recognize at the same time a distinction between elementary consciousness and the full consciousness of an intellectual operation. Many facts in every one's experience bear out such a distinction. We are often conscious without knowing the object or occasion of consciousness; being half-aroused, we feel rather than perceive. It is possible, and from the evidence it is even probable, that provision for this rudimentary consciousness is made by the nerve-masses between the medulla and cerebrum.

Whatever conclusion we adopt respecting this matter, the significant fact remains that consciousness is certain to appear in connection with nerve-matter; sooner or later the question of a strictly materialistic interpretation must be faced. After ascertaining the present state of the case with regard to localization of functions in the cerebrum, the induction must be drawn as to the nature of the relation between nerve-matter and consciousness. Grant that this induction shall be more or less a speculation, we need, I think, to remember that all reasoning is speculative, from the nature of the case speculative, and that the only distinction between credulity and reasoning is this, that credulity is both beyond the facts and contrary to the facts, while reasoning is beyond the facts but *according to the facts.*—Professor W. R. Benedict on "The Nervous System and Consciousness," in *Popular Science Monthly for April.*

GEOLOGY AND MINEROLOGY.

SOME GEOLOGICAL AND TOPOGRAPICAL FEATURES OF SOUTHERN KANSAS.

F. W. CRAGIN, SC.B.

Several hasty excursions made by the writer during last summer, autumn, and winter, through parts of southern and southwestern Kansas, lying in what had hitherto been, scientifically, the least known region of the State,—the facilities for making which excursions he chiefly owes to the liberal policy of the Atchison, Topeka & Santa Fe Railroad Company in fostering the scientific, as well as the industrial development of the southwest,—have afforded glimpses of

that region which show that it is a field of rich promise for the naturalist, as the Easterly portions are also for the agricultural and industrial immigrant.

The region between Newton and Wellington is for the most part destitute of solid rock; along the railroad quite so, though a few thin beds of crumbling shales are exposed in some of the railroad cuttings. At Wellington, and for several miles westward, the streams and draws make their way through a variety of loose shales, the darker of which are locally known as "slates," a misnomer from which the stream that flows by Wellington has derived the name of Slate Creek. As no fossils were found in the country rock of this region, we can only judge of its geological age by its relation to the neighboring formations, and its close repetition of conditions found in northern Kansas. According to these, it would belong to the permo-carboniferous.

At Wellington, however, occurs a local deposit of sand and gravel which affords, as shown by its fossils, a glimpse of quite recent conditions. The material of this deposit shows the oblique lamination characteristic of rapid and shifting currents. The occurrence in it of numerous unworn fragments of the same argillaceous and calcareous shales that outcrop in the neighboring ravines, together with the gravels of the region immediately northward and westward, show that it is more recent than the general country rock of that region; and the contained fossils (*Bison latifrons*, *Mastodon*, *Elephas*, *etc.*,) clearly refer it to the champlain.

The further occurence in it of beds of recent fresh-water shells taken in connection with the evidences of torrential currents, show that we once had here a rapidly flowing river. Several of the highly inclined wedge-shaped strata of this deposit, though of so recent origin, have been converted into solid sandstone, but the exposure of this sandstone indicates hardly more than a dozen or twenty cubic feet. There occur also here, as in the creek-bed adjoining, curious thin concavo-convex concretions of clayey limestone,* whose form, except for the lack of sutures, often reminds one of the occipital or parietal bone of a human skull. These have perhaps been caused, as is the opinion of Judge Simmons, of Wellington, by the efforts of gases to escape through the strata while the latter were yet in the condition of half-hardened mud.

Westward of the Wellington shales, the country rock is a rusty-brown sandstone. This sandstone is quite similar to that of the Dakota belt which enters the State on the north in Washington County, and, though the single fossil, *Gryphea Pitcheri*, which I have thus far found in it, is insufficient to determine its exact age, the "ironstones" in which it abounds, taken in connection with the known geographical distribution of the Dakota and absence of Jura-trias northward, leaves little doubt that it belongs to the Dakota, and as such we shall here consider it. On this view, the Dakota member of the Cretaceous in Kansas extends in a belt one or two counties in width from Washington County southwest-

* In several instances I obsereved large irregularly rounded lumps of red clay in this Champlain deposit. If I remember correctly, Judge Simmons has spoken to me of finding similar lumps equal in bulk to an ordinary barrel. These are, of course not *boulder clay;* but I am unable to account for them at present.

ward to Rice, and thence slightly to the east of south, passing into the Indian Territory mainly from Harper County. It has been shown by Mudge to send an arm eastward, along the divide between the Kansas and Arkansas Rivers, to the highlands of Morris County and another westward into Colorado along the latter river, by whose ancient erosion it has been laid bare. In the southern tier of counties, the most easterly exposure of it that I have been able to find is at Milan, in the western part of Sumner County. It occurs also in the bed of the Chikaskia River. Westwardly of this, it is the main country rock as far as the Gypsum Hills (of which it forms the base) west of Medicine Lodge. It has also been exposed by the erosion of the Medicine River and its tributaries at least as far as eastern Comanche County and, near the southern State-line, by a more extensive erosion, further westward, probably into southern Ford County. I have reason to think that it will be ultimately found as far west as the junction of Crooked Creek with the Cimarron River.

In travelling by carriage from Harper to Medicine Lodge, the streams are found to be quite unlike those for which Kansas is so generally reputed. Instead of the slow muddy creeks so largely characteristic of eastern Kansas, are seen rapid brooks,—veritable brooks, with waters limpid as crystal, flowing often over beds of quartz pebbles which, for variety and beauty of colors, would challenge comparison with New England itself. The origin of these pebbles is not far to seek. Capping a line of low bluffs of the Dakota sandstone (the first bluffs we have met in travelling westward from Harper), which extends westward from a point near the Harper-Barbour boundary westward, we shall find a bed of conglomerate, perhaps a foot thick, composed of these same colored pebbles, and in the very act of liberating those pebbles by disintegration. This is certainly the origin of a part, at least, of the pebbles, and is probably one of the persisting members of the tertiary which formerly spread, apparently, over the entire region in Kansas south of the Arkansas River and west of Sumner County, and whose remnants, chiefly in the form of gravel and pebbles mingled with the Dakota sand, may be found in Harper, Kingman, Reno, Pratt, Barber and perhaps other counties. Near the junction of Kingman, Harper and Barber Counties has been dug up, at a depth of something like twenty feet, the metatarsal of a Pliocene horse, indicating an animal of good size and with the peculiarity of very *unequal splints*, a feature not known, I believe, in any Tertiary horse prior to the finding of this specimen. This is undoubted evidence of Tertiary for this region; but it must be borne in mind that these Tertiary deposits *may be modified* deposits, and if this is the case the conglomerate above mentioned may belong to the Dakota, as indeed may be the case in either event, since such conglomerates occur in the Dakota elsewhere.

The great mass of the Dakota sandstone is friable. It appears to be mainly the lower beds that afford stone of sufficient durability for building purposes. In the region about Harper there is a considerable quantity of stone that can be so
in the vicinity of Attica and Sharon a few thin layers; and from there west-
generally, very little indeed.

While the ironstones are exceedingly abundant, they usually contain so much silica that they could probably not be profitably worked for their iron, even if coal were at hand. Some specimens, however, are nearly free from silica. These bear a striking resemblance to bog-iron ore, and it is possible that, could coal be discovered in close proximity, they might be found in some sections in sufficient quantity and purity to pay for working.

Besides the concretions of iron and silicate, others of lime are common in much of the sandstone. These usually have one side convex and covered with nodular protuberances, the other showing one or more concavities lined with small crystals of calcite.

While the concretions of iron will probably yield no one a fortune, and we should not look even for farthings in limestone concretions, these plain aggregations of common minerals are promissory notes to the farmer that should make his face beam with joy whenever his eye falls upon them. They are as good to him as gold certificates, for they tell him of unstinted gold which they have spread before him and which shall be his for the stooping and taking.

Concretions are formed—often about an organic nucleus—where their component originally existed in small quantities diffused through the rock in which they occur. Their *rationale* is little understood, but that such are the *conditions* of their formation is a matter of observed fact. Lime and iron, then, in a diffused state and in small quantities once existed in this sandstone, the former probably mingled to some extent with traces of phosphates and sulphates. It is plain of the iron, as shown by the color of the sandstone, and is doubtless equally true, if less evident, of the lime and other mineral constituents, that they are but partly expressed by these concretions and that they are therefore still diffused through the strata to greater or less extent, and so in the soils that have resulted from its decomposition.

If to such a soil have been added, as is here probable, small contributions from the gypsiferous clays that once overlaid the sandstones, and still later from the tertiary, the result would be a soil of unsupassed fertility and adapted in the highest degree, by reason of the porosity and capillarity of the sand, to raise large average crops with a small average rainfall, and to withstand drouth when other soils would fail.

Such is the soil of the Dakota belt, at least in southern Kansas. Nor could a better combination of ingredients be found for road-beds. I have driven between Harper and Medicine Lodge in sunshine and in rain, and have found the roads neither dusty nor muddy. Indeed dust and mud are well nigh impossible in such a region, except where some "settle" has accumulated an undue proportion of lime and clay, and these spots are small and the mud shallow.

The only really bad portions of the roads are found along the streams where the waters have washed out the lighter ingredients of the soil, leaving the sand. Here, as in all loose sand the traveling is heavy.

The streams of this region are mostly without appreciable banks, the larger ones, and many of the smaller, having their little sand-hills, and thus aping the

great Arkansas, with whose turbid flood their clear and sparkling waters are in marked contrast.

West of the Wellington shales, native trees soon disappear and we see nothing worthy the name of a tree of spontaneous growth, save one lone cottonwood and a small clump of woods in a ravine far north of the "trail," until we reach the valley of the Medicine River. Here and thoughout the great cañon system tributary to this river, we find the ravines uniformly, if not heavily, timbered. Now almost wholly composed of deciduous trees, the timber in these ravines once embraced many red cedars. Especially did these thrive upon the slopes of the ravines and the faces of the bluffs, and many of them were of great size. They were cut down by the early settlers, many of whom would have starved to death, but for the friendly presence of the cedars and the buffalo bones, which it is said, they hauled to Hutchinson and sold. The deciduous trees include much the same species as occur in eastern Kansas, but less of cottonwood, while elm is particularly abundant.

Next month we shall give some account of the great gypsum deposit of the Dakota or Benton, which lies in Barber and Comanche Counties and which gives to Kansas another and very prominent "gypsiferous horizon" which has hitherto escaped the attention of our geologists; together with a brief notice of the great "Salt Well" of Ford County, notes on some striking relief-features of southern Kansas, and notes on its palæontology and natural history.

[*To be Continued.*]

MINERAL BELTS OF THE CONTINENT.

PROF. J. VAN CLEVE PHILLIPS.

Take one of our numerous continental railroad maps that shows the topography of the mountain system of Sierra Nevada, Sierra Madre and the basin between them, and draw a blue line from Alaska along the great watershed of the Rocky Mountains to San Luis Potosi in Old Mexico, and another line to follow the Sierra Nevada from Van Couver's Island to Zacatecas. Make these lines one-half inch wide with a camel's hair pencil. In the State of Zacatecas these mountains come together, and going south separate and form the vein of the basin in which the city of Mexico is located. Going farther south these watersheds again come together in the State of Ozaca, where silver and gold mines are found. The mountain range then narrows and runs single through Central merica and the Isthmus of Panama.

The eastern belt crosses the Rio Grande where that river bends north and orms the Santa Rosa Mountain Range in the State of Coahuilla. Along this range a silver vein can be traced for 100 miles, and anthracite coal follows the silver half a mile distant to the east. What are known as the Santa Rosa silver ι this belt.

Going south this mountain terminates in round knobs from 500 to 1,000 feet high that form a mountain range to San Luis Potosi, where these belts bisect each other, and which explains the great silver veins worked by the Spaniards in the States of San Luis Potosi and Zacatecas.

The reader will now have in his mind's eye these two great silver streams, that reach from Behring Straits to the Isthmus of Panama.

The Sierra Nevada or Pacific Coast Range passes into Old Mexico in the State of Sonora, and following the coast forms the Cordillera or Andes of this continent.

Between these mountain ranges at the south is the high basin of the City of Mexico, coming north the Mexican Desert or Bolson de Mapimi, which at its north end forms the San Luis Valley, and farther north the basin of Utah, Arizona, New Mexico, Nevada, Oregon and Washington Territory, to Alaska.

The lines must follow the center of these great watersheds in their sinuous and serpentine courses, as they wind around at the heads of a thousand streams that flow east and west, and form the heads of great rivers of the continent.

A line on the west side of the Sierra Nevada, to follow the local watersheds and centers from which the streams radiate from Alaska through Oregon, California, Sonora to El Oro, in Durango, Mexico, and from there south to the Isthmus, covers the native gold and silver belt of the continent. This belt should be colored yellow.

In 1878, in going from Parral, Mexico, to Inde, a dry placer gold field was crossed seventy miles wide. El Oro is in the southern part of this field. The head waters of the Nueces and Sistine Rivers descend from the Cordillera, and run east; along the ribs of this chain the gold bearing quartz veins must be looked for. The country is black clay slate disrupted by granitoid rock, and in geology it is the duplicate of the California gold field.

There are evidently untold millions of dollars in the dry gulches of this gold field, and all that is needed is ditches to bring the water. Here is an opening for a large number of our floating mining population to invade industrially and peaceably our sister Republic. The climate is good, living cheap, and gold easy of access, to be worked by small parties with their individual labor.

This is one of the first steps for the native miner to study up practically ; the vein system of the silver and gold fields of Mexico. There are other Comstocks, Silver Kings, Veta Grandes, and native silver veins as found at Batipilos to be opened along these two belts and in the basins between them.

We now have in the mind's eye the silver and gold framework of these two mountain ranges, and now comes the embellishment of this topographical picture. Along the sides of these mountain ranges and in the great basin between them, are lesser drainage centers, marked by conic mountains that have their satellites or lesser conic hills around them. These stand as sentinels along the great continental divides, as the Black Hills, Pike's Peak, Leadville, Mount Davidson, and boofas as at Parral, Inde, and hundreds of others from the Canada line to the halls of the Montezumas. These outlying knobs are the fixed stars of this stellar

silver and gold belt. Each conic mountain and its secondary knob is a watershed for an individual family of gold and silver-bearing veins; but a small part of these stores of metal has yet been touched. This latent wealth is to form the banking capital of the people of the future. The backs of quartz veins and blossoms on them looked much the same when the pyramids of Egypt were being built as in A. D. 1500. Each atom of metal in these veins has been deposited with direct reference as to its drainage. The vein system was seen in the ideal by the great Architect, and each atom followed its elective affinity, discriminative power of attraction and bias, and laws that filled these atoms in the vein system and outlying centers and basins have their counterpart in the human mind. The geology of this vein system is now all written in the "great stone book;" nothing can be added or taken away, but only translated, and observing explorers, by a study of the topography, mineralogy, geology and vein system of these great belts and drainage centers, can locate the undeveloped Comstocks, Silver Kings, and Veta Grandes of the future.—*Mining World.*

WEST VIRGINIA'S TIN MINES.

It is not generally known that there are in successful operation in West Virginia two tin mines. One is near the city of Huntington, in Cabell County, and the other about five miles from Grantsville, in Calhoun County, on Laurel River. Unfortunately it is a considerable distance from a railroad and on very bad ground for hauling. The Calhoun County mine, which is the most extensive, is owned by State Senator T. J. Farnsworth, of Buckhannon, this State, and B. Ridgeway, of Staunton, Va. Two years ago all this land was regarded as comparatively valueless, except for the splendid timber, and was a slow sale at fifty cents an acre. The same property is now held at hundreds of thousands of dollars. The tin is practically inexhaustible. The opening of the mine is directly in the face of a great hill. The rock is extremely hard, and blasting and drilling are constantly necessary. The product is of a bluish gray color. Primitive machinery for the manipulation of the ore is in operation, and scores of curious visitors daily visit the place. P. B. Wilson, of Baltimore, assayed the ore, and found it to contain 42 per cent of tin. As soon as the necessary arrangements can be made smelting-works on an extensive scale will be erected. Eastern capitalists own the mine in Cabell County. It is believed that the Calhoun County vein extends miles across the country to the Great Kanawha River.

THE MEXICAN TIN FIELD.

The *Tribune* of Durango reports that about ninety miles northwest of that city and 125 miles from the station of Villa Lerdo, on the Mexican Central Railroad, is the small town of Coneto, with about 1,000 inhabitants, and situated in the center of the tin region of Mexico. It bears traces of having been much

larger in size and a very prosperous mining town. It lies in a gulch at the foot of a chain of mountains, called San Francisco, and its population derived and still derives its living chiefly from mining and smelting tin ores found in the above mountains. The San Francisco chain is one of the lateral branches of the main chain of Rocky Mountains, and is about 100 miles in length and from forty to sixty miles in width. Throughout its length and width it is a series of abrupt peaks, rocky cañons and some occasional grassy slopes and long but narrow valleys. The whole of it is heavily wooded with oak and pine, but is almost waterless, although during the rainy season many unfordable mountain torrents are met with there, and the grounds offer at many points facilities for damming, where a short dam, if built, would entrap an extensive reservoir or a series of reservoirs of water. Toward the southwestern end of this ridge is the central point of the Mexican tin region. Its extent is about 150 miles in length and about the same in width.

The tin ore found there is principally red and black cassiterite of extreme purity, and this is found either in veins which fissure in all directions these peaks and their slopes, or in placers, in gulches and valleys at the foot of the peaks and slopes. As the foot of all ridges and slopes where a vein exists, a placer of tin is invariably found. Sulphuret of tin, similar to Cornwall, England, tin stone, has also been found, but, so far, only in one point of these mountains; while arseniate of tin and also very finely divided red ophite of tin are met with in many of the numerous veins already tapped. The massive cassiterite is usually found in the veins in continuous streaks of various widths, the ore being, of course, easily separated from its gangue, and containing from 70 to 80 per cent of metallic tin. The veins are very numerous, and although many of them are cut into, and some have been worked quite extensively, it is a certainty that only a small percentage of them are known at present, and a great many more could be found by judicious prospecting.

PHYSICS.

ELECTRICITY AND MAGNETISM.[1]

PROF. FRANCIS E. NIPHER.

It was known six hundred years before Christ that when amber is rubbed it acquires the power of attracting light bodies. The Greek name for amber, *elektron*, was afterwards applied to the phenomenon. It was also known to the ancients that a certain kind of iron ore, first found at Magnesia, in Asia Minor, had the property of attracting iron. This phenomenon was called magnetism. This is

1 Introductory to the course of Lectures on Physics at Washington University, St. Louis Missouri.

the history of electricity and magnetism for two thousand years, during which these facts stood alone, like isolated mountain peaks, with summits touched and made visible by the morning sun, while the region surrounding and connecting them lay hidden and unexplored.

In fact it is only in more recent times that men could be found possessing the necessary mental qualities to insure success in physical investigation. Some of the ancients were acute observers, and made valuable observations in descriptive natural history. They also observed and described phenomena which they saw around them, although often in vague and mystical terms.

They, however, were greatly lacking in power to discriminate between the possible and the absurd, and so old wives' tales, acute speculations and truthful observations are strangely jumbled together. With rare exceptions they did not contrive new conditions to bring about phenomena which Nature did not spontaneously exhibit—they did not experiment. They attempted to solve the universe in their heads, and made little progress.

In mediæval times intellectual men were busy in trying to set each other right, and in disputing and arguing with those who believed themselves to be right. It was an era of intellectual pugilism, and nothing was done in physics. In fact, this frame of mind is imcompatible with any marked success in scientific work.

The physical investigator cannot take up his work in the spirit of controversy; for the phenomena and laws of Nature will not argue with him. He must come as a learner, and the true man of science is content to learn, is content to lay his results before his fellows, and is willing to profit by their criticisms. In so far as he permits himself to assume the mental attitude of one who defends a position, in so far does he reveal a grave disqualification for the most useful scientific work. Scientific truth needs no man's defense, but our individual statements of what we believe to be truth frequently need criticism. It is hardly necessary to remark also, that critics are of various degrees of excellence, and it seems that those in whom the habit of criticism has become chronic, are of comparatively little service to the world.

The great harbinger of the new era was Galileo. There had been prophets before him, and after him came a greater one—Newton. They did nothing of note in electricity and magnetism, but they were filled with the true spirit of science, they introduced proper and reasonable methods of investigation, and by their great ability and distinguished success, they have produced a revolution in the intellectual world. Other great men had also appeared, such as Leibnitz and Huyghens; and it became very clear that the methods of investigation which had borne such fruit in the days of Galileo, were not disposed of completely by his unwilling recantation; it became very clear that the new civilization which was dawning upon Europe, was not destined to the rude fate which had overwhelmed the brilliant scientific achievements of the Spanish Moors of a half century before.

Already in 1580, about the time when Galileo entered Pisa as a student, Borroughs had determined the variation of the magnetic needle at London, and

we have upon the screen a view of his instrument, which seems rude enough, in comparison with the elaborate apparatus of our times. The first great work on electricity and magnetism was the "De Magnete" of Gilbert, physician of Queen Elizabeth, published in 1600. Galileo, already famous in Europe, recognized in the methods of investigation used by Gilbert the ones which he had found so fruitful and wrote of him, "I extremely praise, admire and envy this author."

Gilbert made many interesting contributions to magnetism, which we shall notice in another lecture, and he also found that sulphur, glass, wax and other bodies share with amber the property of being electrified by friction. He concluded that many bodies could not be thus electrified. Gray, however, found in 1729 that these bodies were conductors of electricity, and his discoveries and experiments were explained and described to the president of the Royal Society while on his death bed, and only a few hours before his death. If precautions are taken to properly insulate conductors, all bodies which differ in any way, either in structure, in smoothness of surface, or even in temperature, are apparently electrified by friction. In all cases the friction also produces heat, and if the bodies rubbed are exactly alike, heat only is produced.

An electrified body will attract all light bodies. This gutta percha when rubbed with a cat's skin attracts these bits of paper, and this pith-ball, and this copper ball; it moves this long lath balanced on its centre, and deflects this vertical jet of water into a beautiful curve.

If a conductor is to be electrified, it must be supported by bad conductors. This brass cylinder standing on a glass column has become electrified by friction with the cat's-skin. My assistant will stand upon this insulating stool, and by stroking his hand you will observe that with his other hand he can attract this suspended rod of wood, and you will hear a feeble spark when I apply my knuckle to his.

DuFay, of Paris, discovered what he called two kinds of electricity. He found that a glass rod rubbed with silk, will repel another glass rod similarly rubbed, but that the silk would attract a rubbed glass rod. We express the facts in the well-known law that like electricities repel each other, and unlike attract. For a long time the nature of the distinctions between the two electricities was not understood. It was found later that when the two bodies are rubbed together they become oppositely electrified, and that the two electricities are always generated in equal quantity; so that if the two bodies are held in contact after the rubbing has ceased the two electricities come together again and the electrical phenomena disappear. They have been added together and the result is zero. Franklin proposed to call these electricities positive and negative. These names are well chosen, but we do not know any reason why one should be called positive rather than the other. The electricity generated on glass when rubbed with silk is called positive.

Let us now examine the distinction between positive and negative electricities somewhat more closely, aiding ourselves by two cases which are somewhat analagous.

Two air-tight cylinders, A and B, contain air at ordinary pressure. The cylinders are connected by a tube containing an air-pump, in such a way that when the pump is worked, air is taken from A and forced into B. To use the language of the electricians, we at once generate two kinds of pressure. The vessels have acquired new properties. If we open a cock in the side of either vessel, we hear a hissing sound. If a light body is placed before the opening in A it would be attracted, and before the opening in B it would be repelled. Now this is only roughly analagous to the case of the electrified bodies, but the analogy will nevertheless aid us in our study. If the two vessels are first connected with the air, and then closed up and the pump is set to work, we increase the pressure in B and diminish the pressure in A. To do this requires the expenditure of a quantity of work. If the cylinders are connected by an open tube—a conductor—the difference in pressure disappears by reason of a flow of gas from one vessel to the other.

If we had a pump by means of which we could pump heat from one body into another, starting with two bodies at the same temperature, the temperature of one body would increase and that of the other would diminish. If we knew less than we do of heat we might well discuss whether the plus sign should be applied to the heat, or to the cold, because these names were coined by people who knew very little about the subject except that these bodies produce different sensations when they come in contact with the human body.

Furthermore, we find that whether the hand is applied to a very hot body, or to a very cold body, the physiological effect is the same. In each case the tissue is destroyed and a burn is produced. Shall we now say that this burn is produced by an unusual flow of heat from the hot body to the hand, or from the hand to the cold body, or shall we say that it is due to an unusual flow of cold from the cold body to the hand, or from the hand to the hot body?

Logically, these expressions are identical; still we have come to prefer one of them. It is because we have learned that in those bodies which our fathers called hot, the particles are vibrating with greater energy than in cold bodies, that we prefer to say that heat is added and not cold subtracted, when a cold body becomes less cold.

Now to come back to our electrified bodies. Let us suppose that this gutta percha, and this cat's-skin are not electrified. That means that their electrical condition is the same as that of surrounding bodies. Let us also suppose that their thermal condition is the same as surrounding bodies, ourselves included—that is they are neither hot nor cold. We express these conditions in other words by saying that the bodies have the same electrical *potential*, and the same temperature.

Temperature in heat is analagous to potential in electricity. As soon as adjacent bodies are at different temperatures, we have the phenomena which reveal to us the existence of heat. As soon as adjacent bodies have different electrical potentials, we have the phenomena which reveal the existence of elec-

tricity. As soon as adjacent regions in the air are at different pressures, we have phenomena which reveal the existence of air.

Bodies all tend to preserve the same temperature and also the same electrical potential. Any disturbances in electrical equilibrium are much more quickly obliterated than in case of thermal equilibrium, and we therefore see less of electrical phenomena than of thermal. In thunder storms we see such disturbances, and with delicate instruments we find them going on continuously. Changes in temperature occurring on a large scale in our atmosphere, occurring in these gas jets, in our fires, in the axles of machinery and in thousands of other places, are so familiar that we have ceased to wonder at them.

If we rub these two bodies together, the potential of the two is no longer the same. We do not know which one has become greater, and in this respect our knowledge of electricity is less complete than of heat. We assume that the gutta percha has become negative. If we now leave these bodies in contact the potential of the cat's skin will diminish and that of the gutta percha will increase until they have again reached a common potential—that of the earth. As in the case of heat and cold, we may say either that this has come about by a flow of positive electricity from the cat's-skin to the gutta percha, or by a flow of negative electricity in the opposite direction, for these statements are identical.

In case of our gas cylinders, the gas tends to leak out of the vessel where the pressure is great, into the vessel where it is small. The heat tends to leak out of a body of high temperature into the colder one, or the cold tends to go in the opposite direction. Similarly, the plus electricity tends to flow from the body having a high potential to the body having a low potential, or, the minus electricity tends to go in the opposite direction.

FATIGUE OF METALS.

For fourteen years State Geologist Collett, of Indiana, has been experimenting upon a theory that the best of iron, when subjected to continuous strain, would undergo changes in its structure which would, after a time, render its use dangerous, and that these structural changes were the explanation of many otherwise inexplicably accidents, particularly to railway bridges. He has lately undertaken a systematic investigation, which has resulted in the confirmation of his theory. For experiment he took from the Wabash dam, at Delphi, a number of bolts and spikes, which were, when the dam was constructed, of the best quality of malleable bar iron, as is shown by the battering of the head when they were put into the structure. Of these bolts and spikes he found that seventy per cent of the whole number were as weak as cast iron, while ninety per cent of those which were near the bottom of the dam were worthless; yet of those which were rotten, the tips where inserted in immoveable rocks were fibrous and strong. When broken they showed polished ends to the connecting fibers, indicating that the continued vibrations of many years had polished and rounded the points of fibrous

structure. A similar effect is found in "the partings," or "horsebacks," in coal mines, which become polished and striated by the continuous quiver and motion of the crust of the earth.

Dr. Collett says that all car axles, after a reasonable run, become crystalized two-thirds of the length from the hub and one-third from the outside extremity, rendering them worthless. On one Indiana railroad bridge he found that the bottom parts of the vertical strain pieces were crystalized for from two to four feet in length, and, as a precaution against what would inevitably have caused a great catastrophe, they were replaced. The matter is one of great interest to railways, and the specimens which Dr. Collett has collected in his experiments are to be sent to the Stevens Institute of Technology, where an investigation of the subject has been in progress for years by a scientist connected with the Institute.—*Boston Journal of Commerce.*

HISTORY.

A PAPER ON NEW MEXICO.

FLORA ELLICE STEVENS.

I am tempted to write a slight sketch of the history of this new and yet old territory, not because I imagine that I am in any wise competent for such an attempt, for New Mexico has one of the most interesting pasts of any part of the Union, but that I would like her to have more of an audience in the recital of her history than she perhaps has had, and such an one the REVIEW furnishes me.

New Mexico is even to-day but semi-American; the laws are published in Spanish as well as English, four-fifths of the population speak the former—adulterated to be sure—the Pueblos, the Plazas, the old Spanish names yet linger, and, excepting perhaps Louisiana, she is the most foreign quarter of the United States.

Twenty-five years will radically alter this, the Senors Dorsey and Ingersoll with their Palo Blanco cattle companies are going to push out the Mexican, that is the Mexican as Mexican; but as yet the delightful romantic antique flavor hangs about her. One sees the remnant of the Pueblos casting their pottery in the ancient forms; the descendants of them who followed Cortez mingling with the fairer-countenanced Americanos.

When is mentioned in Mexican history the Indians, it is not the Indians as commonly denominated but the Pueblo aborigines that are considered, the ancient native race, or races, who were far above—in intelligence and civilization—the red men who bear their title. A few of their descendants still exist, dwelling in their pueblos in the ancient commune way. It is with these Indians, now

classed together as the Pueblo Indians, or more properly the Indians of the pueblos, that the history of New Mexico commences.

Cabeza de Vaca, the first European who visited New Mexican territory, found it in the possession of communities who were very different from the nomadic tribes further east, who lived in substantial houses, cultivated the soil, raised cattle, spun cotton, and were in many respects like the followers of Montezuma at the south. They were comparatively an oasis amid the desert of ignorant tribes that stretched about them either way. De Vaca had seen no grain throughout all Texas, but so soon as he reached New Mexico he found fields of corn, beans, pumpkins and calabasas; speaks of annole root used for soap, of the inhabitants wearing shoes of leather, etc.; certainly a creditable degree of civilization.

To-day, archæologically considered, the ancient races are generally classed together as Aztecs—so named from Aztlan, the country of the Gulf of California, from which the Aztecs came. In reality there were several tribes, the most important of which were the Toultecs or Toltecs, the Acolhues, and the Aztecs, who at different periods migrated from their old homes and settled in the fertile portions of what is now Mexico.

The Toltecs left their home in the northwest at Huehuetlapallan, in the year 1 Tecpatl, which is held by some to be 596, by some 594 A. D. They traveled southward for about a century, living a nomadic life, and remaining but a few years in a place. According to Ysidro R. Gondra they after these wanderings settled, and founded a city not far from the present site of Mexico named Tolam or Tula, which became the capital of their country.

Between these and the Acolhuans came the Chichimecas, who were more barbarous, and by some are supposed to be the cliff-dwellers, as they built no houses but lived in caves.

Afterwards came the Acolhues from Tinoacolhuacan, which was near Amaquemecan, the home of the Chichimecas. Their princes married the daughters of the king of the latter, Xolotl, and for a time ruled the Mexico country.

The Aztecs left Aztlan, according to Gondra, in 1064; to Baron Von Humboldt, 1038; to Clavigero, 1170. The latter omits in his accounts two Mexican centuries, or 104 years—a Mexican century consisting of fifty-two years—which probably accounts for the wide difference in the statements of the historians. Their journeyings were most interesting. They at length reached the Casas Grandes in Chihuahua, where is a large communistic building still remaining, three stories in height, with the entrance as in the New Mexico pueblos, on the second floor, which is reached as is theirs, by ladders.

The quite celebrated sheet of hieroglyphics mentioned by Careri represents the travels of the Aztecs from Aztlan to Chapultepec. It was a piece of maguey paper thirty-three inches by twenty-one. In hieroglyphics were depicted a flood, in which a dove was seen, but only one man and one woman were saved. Their march is described "from the place of flamingoes," "through the place of grottoes," etc.; till at length they arrived at Chapultepec in 1245, where the legend

says an eagle they saw perched upon a cactus—which is to-day the design upon the Mexican coat-of-arms—induced them to stop upon that spot and build their capital there.

It is presumed that New Mexico was settled by detachments from the Toltec and Aztec emigrations, who remained in the country and finally became isolated from their kindred, and at length were gradually surrounded by barbarous tribes, among whom they presented the curious picture of a semi-civilized race, losing, however, none of their thrift and intelligence, while preserving their ancient faith after the lapse of years.

Their traditions relate to their protection by Montezuma, who according to them taught them to build their terraced dwellings, estufas, and to keep burning the sacred fires. They called themselves the Children of the Sun, with which luminary Montezuma was held also to be identical. Montezuma, however, is not to be confounded with the king whom Cortez deposed, but was their God, their venerated mythical hero, the kings taking his title.

During all the changes in the governments of New Mexico the Pueblos have always conducted their own. Their principal officer is a cacique, who is elected for life, to whom all disputes are referred, and whose decisions are ever peaceably accepted. As Prince says "What gives special interest to the pueblo dwellings is that nowhere else on the continent are buildings inhabited precisely as they were when Columbus discovered America. In several instances, as at Taos and in the western pueblos, the people are living in identically the same houses that were then occupied."

When the Spaniards entered New Mexico there were four different tribes among these Indians, whose language was totally distinct, so that those of one pueblo could not understand the tongue of another, which, perhaps but twenty-five miles away, is belonging to another group; which is true of those existing to day. The groups at the time of De Vaca were the Teguas, Queres, Piros, and Tanos. The Zuni and Jemez Indians are probably descendants of the Moqui. At the time of the settlement by the Europeans there was in these communities a population estimated by various writers as from 150,000 to 300,000 souls. One strange thing about the language of these tribes is that with the Teguas the words are principally monosyllabic, among the Ineres dissyllabic, while the others could only express the meaning of the commonest objects by words of astounding length. I quote from Prince this example of the word "earth." "In Queres it is *hah-ats*, in Tegua *nah*, in Piros *pah-han-nah*, in Jemez *dock-ah*, in Zuni *ou-lock-nam-nay*." The Tanos to-day are all extinct, but the Indians of the Jemez and Zuni tribes may be added, making five instead of the original four, each preserving its original tongue, and so unlike are they that the different pueblo nationalities when addressing one another use the Mexican *patois* for a common mode of speech.

To Alvah Nuñez Cabeza de Vaca, a Spaniard, belongs the honor of being doubtedly the first white man to ever step upon New Mexico's territory. His

journey was so full of romantic and yet perilous adventures, that I regret I cannot within the limits of this article give an extended account of it.

De Vaca accompanies Narvaez in his expedition, which sailed from Spain June, 1527, the object of which was the discovery of new lands to be taken in the name of the King of Spain, the subjugation of the natives, and principally the discovery of gold and precious metals, the great aim of all the transatlantic adventurers of that time. Of this expedition De Vaca was appointed treasurer. When they arrived off the coast of Florida a number, including the Governor Narvaez and De Vaca, landed and commencing an inland journey—contrary, however, to the wishes of the latter—in search of provisions, of which they were growing scarce, and a better port of entrance for their ships, became separated from the others of whom they never heard further. After experiencing every form of privation, being reduced in numbers by death, and the separation consequent upon the dispersement of different expeditions which were never more heard of, De Vaca and two companions found themselves alone in a country of which they knew neither breadth nor length, among a hostile people. For six years they were held as slaves by the Indians, and subjected to every species of want and abuse. They had gradually wandered westward until at this stage they were probably in what is now Texas. By their superior knowledge of medicine, however, they were enabled to effect many cures among the Indians, and at length came to be looked upon with respect and reverence. They had now been absent from Spain over seven years.

De Vaca, who was the leading spirit had constantly in view the escaping and reaching the Spanish settlements in Mexico, which he presumed to be near. Therefore they were constantly stealing away from one tribe to another. They performed many cures, and did not neglect their religion, but baptized and blessed those who came to them for treatment, and so left for themselves a name among the Indians that Spaniards coming afterwards found held in high regard among the aboriginal traditions.

They traveled northwesterly, and it is comparatively easy to make out the first point where they reached New Mexico, from the narrative given by De Vaca himself to the Spanish king upon his return to his country. He speaks at this place of entering, a country of "settled habitations," undoubtedly the pueblos, which would at once strike the European as different from the tents of the nomadic tribes.

This was in 1535, which may be received as the date the first European entered on New Mexican soil.

De Vaca calls this the "cow nation," as they raised large herds of these animals, and speaks in his chronicle not merely enthusiastically of their civilized habits, and gives the minutiæ of the structure of their dwellings, but of their finer physical proportions and superior intelligence to other Indians.

De Vaca's history is so admirably accurate, and free from exaggeration that his route may be traced without much difficulty, the rivers and ranges named, even the very pueblos distinguished.

His reaching New Mexico seems to be the turning-point for his long and perilous wanderings; he was well treated by the Indians, and soon heard rumors of the Spaniards which led him to turn his steps south, and in 1536 to reach the goal of his hopes, with his companions, the City of Mexico; whence they embarked for Spain, which they gained ten years after the fated expedition had left it to conquer, as they fondly expected, a new country across the seas.

But Alvah Nuñez Cabeza de Vaca had won one title, which as she grows in wealth and fame will be one for history to value: i. e. *The first white man to step on New Mexico's soil.*

[*To be Continued.*]

THE UNITED STATES AS IT WAS IN 1780; AS IT IS IN 1880; AND WHAT IT WILL BE IN 1980.

E. A. HICKMAN.

There is no problem likely to be presented to the statesmanship of our country in the next century, that requires as much deep analyzing wisdom as the one that demands homes and employment for the young men and women who are forming so vast a proportion of our population. To see this subject as it advances and increases in importance and magnitude we must look into the past and present, and from them anticipate the future.

I will give the population of the United States in 1780 and at the various decades since, with the per cent of increase in each period of ten years:

	Population.	Gain, per cent.
1780	3,070,000	
1790	3,930,000	28
1800	5,308,000	35
1810	7,240,000	33.4
1820	9,659,000	33.2
1830	12,866,000	32.6
1840	17,069,000	35.8
1850	23,192,000	35.6
1860	31,443,000	24
1870	38,978,000	34.3
1880	50,156,000	30

In the century past the population has increased at an average of 33 per cent compounded every decade. In that century, too, that population had hardships and impediments to surmount that may not impede progress or delay the increase of the next. In that century, the active and inventive mind of the ican mechanics and scientists has invented, and constructed, and patented o improvements on the old order of things, that the burthens and labors of

life may be less oppressive; and of these all shops, farms, offices, stores, mills, boats, and railroads bear valuable fruits, and these classes of our citizenship have removed many hardships and privations; and those common to the beginning of the period mentioned, are unknown to those who live in the later years.

In the beginning of that period, and from that on till now, the United States Government has had a vast domain of public lands for all who wanted farms; and liberal provisions were granted to every one who chose to locate on vacant land. Thus from any over-crowded locality the excess simply flowed into this vast territory of unimproved land, and in a few years where there had been apparently a barren waste, there sprang up States with all the necessary functions of like governments a hundred years older.

To-day the area of the United States is. . . .	3,110,061
square miles exclusive of the Indian Territory.	70,600
And of Alaska	720,000

This first area will equal a square whose sides are 1,764 miles long. This extensive expanse has been nearly all taken up by private individuals, and but little more is left for the pioneer.

What is now before the statesmen of our country for their prime consideration? It is this: How shall the vast increase of our next century (if it be in proportion to the last in per cent) be supplied with homes and honest employment? These are necessary to the individual and the family; to hold them up in self-respect, and keep them on an elevated plane of citizenship where childhood and youth can be reared into maturity, pure, noble, and grand, as God wanted *Man* to be; then with the *will* to labor, and the *place* to labor, he can go on in obedience to the Divine Command and live, and grow in mind and morals and perfect himself. How much space *per capita* will the ending of the next century demand?

The 3,070,000 population of 1780 has grown in one hundred years to 50,156,000 and has extended from the confines of the thirteen Atlantic States containing an area of 800,000 square miles to one of 3,110,061 miles, and embracing thirty-eight States and seven territories, all politically organized to furnish their citizens with the benefits of civil government and such guarantees as will enable families to rear their children with judicious efforts to honorable and respectable man and womanhood. Then if the 3,070,000 population of 1780 make an increase to 50,156,000 in a century, that last number in the next century will reach at the same ratio of increase 852,000,000 of people.

What provisions must be made for this enormous population? It must be supplied with honest respectable labor to keep it above the ruinous sinks of vice, and to supply food, raiment and house-room. How can that labor be applied to supply these necessaries?

In the various manufacturing departments now in operation by the use of the improved machinery before alluded to, an over-supply is now on the market,

and dealers say there is but little profit in their trade. The farmer complains that his productions do not pay interest on his investment and for his labor.

The mechanic says his labor during the summer and fall months does not supply him with funds to sustain his wife and children during the idle days of winter, and the day laborer often suffers for the necessaries of life when summer and fall work has past. If that be the condition of our population of to-day, what must it be a hundred years hence?

American citizenship of the nineteenth century is unlike the social condition of any former populace known to history. In other periods that have gone, there was an alliance demanded by the land-owner, and granted by the plebian, who felt his inferiority because he was not an owner of land, and subject to the will of him who was.

A widely different state of things exists here; in the hundred years past, American thought, American character, American freedom, all have been cultivated into an unity, and become an object which so many of the rising generation are seeking to attain.

It is this freedom,—this effort to rise,—this persistent and logical thought of the young and laboring classes that have given our government some of its wisest and best men. Our great systems of internal improvements have been built by the capital made by the energies of the country-raised boyhood, and some of the finest works of civil engineering are from the same class, and inventions that have revolutionized the commerce and civilization of the world have grown out of the same class of mind. Nothing so loudly proclaims the value of boyhood effort as the successes that have rewarded many citizens in every community.

But these vast demands for skill, and energy, and capital are ceasing. The railroads have been built; the streams have been bridged, the saw-mills have been constructed and worked up the forests into lumber; the flouring-mills are more than able to grind up the wheat production. The towns and cities have an over-supply of dealers in all branches of trade. The farmers are all supplied with buildings, and that most profitable and useful class of works known as agricultural machinery has supplied all previous necessities, and there is enough left to furnish the future demand for five years. Where now, with all demands supplied and enterprises comparatively finished, must the young men and women look for such work as will supply the wants of life and give such vitalizing influences to the germs of true greatness, as will elevate them above the degrading effects of idleness?

This freedom of American thought has in so short a time, worked such wonderful results and created such vast supplies, that it has to stop and ask "What must I do next?" Cannot some man of broad, perceptive thoughts rise and answer the enquiry, before the problem becomes entangled with other issues?

INDEPENDENCE, MO., February 25, 1885.

THE RENAISSANCE IN ITALY.

WILLIAM SHIELDS LISCOMB.

The fervor which had previously been felt by individuals now permeated society. A sense of the importance of culture took complete possession of Italy. It had come slowly and uncertainly, as a morning beset with clouds, in which the contest between light and darkness seems for a time doubtful. Yet men, peering across the sea on whose borders they had so long been wandering, saw the mists begin to lift, and at length descried the farther shore. Enchanted by the vision which, like some magnificent mirage, arose before their gaze, they stood for a moment spellbound; then reverently knelt to pay their adoration and offer their gifts at the cradle of this new-born redemption for the race. The conviction pervaded all classes that antiquity alone had power to rescue the world from the evils with which it had been so hopelessly struggling. "Like islands of safety in the midst of the universal deluge," says Grimm, "the ideas of the great minds of the past emerged; in the general confusion men fled to them for refuge." In city after city the flame of enthusiasm burst forth. Youths forsook the warehouse and the tavern to consecrate themselves to learning. Merchants stole away from their counting-rooms to converse with literary friends, or listen to the lectures of eminent professors. Captains of adventure read Virgil and Livy by the camp-fire, or in the pauses of the march. Noble ladies fled from the *ennui* of seclusion, and exchanged the trivial gossip of courts for the priceless treasures of knowledge. Princes spent fabulous sums in the patronage of humanists, artists, and authors. Peasants sought for their sons a place in the republic of letters, where genius was everywhere acknowledged as the peer of birth. The leaders of the *demi-monde* applied themselves to the poetry, rhetoric, and philosophy of Rome, in order to acquire that development and elegance of taste which should fit them, like Leontium and Glycera of Athens and Diotima of Mantinea, for companionship with the wits and thinkers of their time. Municipalities furnished employment to skillful Latinists as secretaries, chancellors, and ambassadors.

Popes vied with sovereigns in encouraging and promoting the very things which their predecessors had denounced as damnable. The Medici and other great Florentines directed their correspondents to purchase relics of antiquity at any price, and their ships came home laden not only with costly merchandise, but with precious codices, busts, statues, reliefs, and other objects of virtu. Nicolò Niccoli sat at a table with his friends, discussing the questions then uppermost in every mind, and eating from fair antique vases, while his house was literally packed with inscriptions, coins, marbles, and engraved gems, purchased without regard to cost, or sent him as gifts by those who knew his love of such things. The learned rejected their own names in the vulgar tongue, and assumed Latin titles instead. Pagan writers were quoted in the pulpit on an equality with the Fathers of the church, and at length, in the estimate even of high eccle-

siastics, were set far above them. "Give up those trivialities," wrote Cardinal Bembo to Sadoleto, in allusion to the Epistles of St. Paul, "for such inelegancies are unworthy a man of dignity," *Omitte has nugas, non enim decent gravem virum tales ineptiæ.* The coins of Mantua were marked with the head of Virgil. Pius II. granted amnesty to the inhabitants of Arpino because it was the birthplace of Cicero, and Alphonso the Magnanimous forbade his engineers to trespass on the site of the orator's villa at Gaeta. Pomponio Leto delighted in leading the life of a Roman sage; tilling his ground in a manner described by Varro and Columella; eating his frugal meals, like a veritable Stoic, beneath the branches of an oak tree on the Campagna; and directing that after his death his body should be placed in a sarcophagus on the Appian Way, amid the tombs of the republican and imperial age. The class-rooms of professors were crowded to overflowing with pupils from every grade in life, eager to catch each word that fell from the teacher's lips. The palaces of wealthy citizens were thrown open to the disciples of erudition, and in them assembled those brilliant coteries of scholars whose discussions of ancient authors gradually unlocked the secrets of the past, and made them accessible to all mankind. The scenes which were presented on occasions like these must ever possess an indescribable charm. As the modern traveler stands in the magnificent gardens of Careggi, overlooking Florence, with the Arno stealing silently away to lose itself in the purple Mediterranean, the prospect of beauty before him vanishes like some lovely dream, and in its place return those morning hours of newly awakened intellectual life, when Lorenzo, "the sure anchor of the storm-tossed muses," gathered the members of the Platonic academy about him, and spent the long hours of the afternoon in drinking deep from that pure fount of truth, whose waters have refreshed the thirst of great spirits in every age. Then, when their minds had become wearied by concentration, they seated themselves about the board of their munificent host; rising from it to wander forth among the acacias, rose trees and laurels, while the air of evening, loaded with the perfume of countless flowers, fanned their temples back to coolness, and the calm stillness of the Italian twilight stole over the landscape, whispering to them each its message of peace. Strolling thus amid the garden beds, and communing with each other's thoughts, while day slowly vanished from the sky and the silent stars came forth one by one above them, with the lights of Florence twinkling in the distance and the Apennines and the mountains of Carrara sleeping in the east and west, what emotions must have thrilled their souls, what visions have been caught sight of, what hopes, aspirations, and high resolves have been theirs, as this new consciousness of power was awakened within their breasts! What wonder is it that these men were able so to impress themselves upon their generation; that Politian could tune his lyre to the language of the three great nations; that Pico della Mirandola, at the early age of twenty-three, should have proposed his famous nine hundred theses at Rome, offering to dispute with all comers on any subject in the entire domain of knowledge; that Michael Angelo, even, should have produced the Moses and the Sistine Chapel, or have sculptured those wonderful figures which sleep the centuries away on the Medicean tombs!—*February Atlantic.*

ASTRONOMY.

WHAT WERE THEY?

LOUIS WATSON, M. D.

On the morning of January 20, 1865, the Second Division of the 14th Army Corps, under the command of General Jas. D. Morgan, left Savannah on the march toward Richmond. About 8:00 o'clock on that morning when in the act of mounting my horse to accompany the General, as usual upon a movement as one of his staff officers, I observed upon the Sun, at that time through an elevated fog appearing as a deep red disk, two round black spots. They were near together, one much larger than the other, the lesser one as large as Venus appeared to my naked eye in its last transit, the larger one of triple or quadruple diameter. I lingered two or three minutes to observe them, then moved on with the Sun behind me. That day and the three following days proved cloudy and more or less rainy, the Sun not again becoming visible until a clear day on the 24th. No smoked glass, nor a substitute for one being convenient, I made no further observation. If these objects were "sun-spots"—at the time I imagined them to be nothing else—I very well knew that they were *remarkably* large ones, and from the duration of their presence as "sun-spots" that they could not escape the observation of astronomers and I confidently expected that after leaving the service I should meet with some account of them. In this anticipation I have been disappointed. In 1879 at a neighbor's house I picked up Tice's almanac for that year and among other matter I read what he had to say about "Vulcan" and its satellite. This article recalled my observation at Savannah and I wrote to Mr. Tice giving him an account of it and inquired if what I had seen could possibly be a transit of his "Vulcan." The following in his reply *verbatim et literatim*, but the words within brackets correcting an obvious error, are mine:

St. Louis, Mo., October 4, 1879.

Dr. Louis Watson, Ellis, Kansas.

Dear Sir:—"Yours of 1st inst. received. It would puzzle me to account 'for the black round spots observed by you in Jan'y, 1865, if I had not arrived 'at the conclusion and published it long ago that there were two principal inter-'mercurial planets attended with satellites, that they were one-half of a revolu-'tion apart and revolved in the same period, 23,026 days. One's orbit seems to 'make about 14° with the Ecliptic (which is the one I saw) and the other about '76° (which you saw). If you saw it on the 20th of January then it intersected '[the plane of] the earth's orbit in 120° heliocentric longitude where the earth

'was on that day. My Vulcan I find on that day was at 301° heliocentric long-'itude or ½ revolution plus 1° from yours. It is only to be regretted that you 'did not make observations to see whether it moved and what was the direction 'of its motion, probably at its descending node, as it was seen at its ascending 'node again with a companion on 20th July, 1876. Now the earth is at 302° 'heliocentric longitude on July 20th. 1876, was a leap-year, hence on that day 'in that year it was 301°, or just half a revolution plus 1° from where you saw 'it. This observation was made in California with the naked eye as I under-'stand yours to have been. I write in a great hurry, as I am closing up some 'scientific matter before leaving for Wisconsin and Iowa. I am very thankful 'to you for the information.

Respectfully, JOHN H. TICE."

I had no further correspondence with Mr. Tice, and I do not know whether or not he ever published the facts I gave him. If Mr. Tice's statements in the above letter are *true*, there appears to me to be a coincidence worthy of notice. At any rate I feel that my observation, as short and imperfect as it was, should go upon record *somewhere*. My statement of the time when, place where, and circumstances under which I saw the objects mentioned, *is true*. The question is, What were they?

NOTE.—Having been requested by Dr. Watson to submit the above article to some experienced astronomer, we sent it to Prof. C. W. Pritchett, of Morrison Observatory at Glasgow, Mo., who replied as follows:

EDITOR REVIEW:—On this correspondence I can afford but a few brief notes

First. So far as I am informed, there were no *remarkable* Sun-spots in January, 1865. Surely they would have been *remarkable*, for *two* of them to be seen at *once* with the unassisted eye. Had they continued several days, they could not have escaped the attention of astronomers in some parts of the world. The veteran observer Schwabe, of Dessau, devoted a long life solely to the observation of Sun-spots. He observed the Sun on 307 days of 1865; and found but twenty-five days on which the Sun was entirely free from spots; but they were small groups, and entirely telescopic. Had these spots been *sudden* and *transient* outbursts of solar activity, even though they escaped detection on the Sun's disc, it is not probable that they would have been unattended by very marked magnetic and auroral displays—such as attended the great spots, at their rupture in April and September, 1882. It now seems to be well ascertained, that magnetic storms and remarkable auroras are always counted, in time at least, with disturbances on the Sun. I am tempted to cite numerous instances, but forbear.

Second. It is entirely improbable that the phenomenon was a transit of intra-mercurial planets. If such planets exist, it is quite certain they are much smaller bodies than Mercury; and it requires *preparation*, *effort* and *close scrutiny* to detect Mercury with the naked eye, on the Sun's disc, even when we know he is projected there. It is quite improbable that the *unaided eye* would ever have

detected Mercury or Venus when in Transit if the theory of planetary motion had not led us to *look* for them there, at certain times. As to the probable *existence* of Vulcan, I beg leave to quote a paragraph or two from Prof. Holden's Report on the great Solar Eclipse of May 6, 1883, observed at Caroline Island, S. Pacific Ocean. The report is published under the auspices of the National Academy of Sciences:

"At the eclipse of 1878 it was a question whether the planet *Vulcan* of Le Verrier existed or no. At the eclipse of that year, I searched for such a planet over a space of 320 square degrees and found none." I may add, that Prof. Asaph Hall, myself and others, all searched for it, with the same result.

Prof. Holden continues: "At the same eclipse, Prof. Watson reported the existence of two new and much smaller bodies which he saw with a four-inch telescope and a magnifying power of forty-five. Prof. Swift also reported the existence of two different (and new) bodies. At the *present eclipse* I looked for these with a magnifying power purposely chosen the same as Prof. Watson's and with an objective giving more than twice the light of a four-inch. No such new bodies existed within the space marked on the map (See *Science*, No. 3, February, 1883). It is my opinion, therefore, that at future eclipses, it will not be necessary to devote an observer and a telescope to the further prosecution of this search, and I must regard the fact of the *non-existence* of Vulcan as definitely settled by Dr. Palisa's (Imperial Observatory, Vienna,) observations and my own." Page 101, Memoir.

Third. Dr. Watson tells us he lingered but a short time to observe them, and then moved on, riding with his back to the Sun. With all deference, I think the statement leaves abundant room for the play of "optical illusion." There are conditions of the eye and the atmosphere, which make this entirely possible, even in despite of our own conviction to the contrary. Some persons always see an *intensely black spot* at the center of the headlight of a locomotive, two miles away. The most learned and careful astronomers now living have sometimes for years been imposed on by optical illusions. They are by no means uncommon. Sometimes the cause is purely *subjective*, at other times there is some *objective* reality arising out of the laws of refraction, reflection and dispersion of light. It is well known that Le Verrier's elements of Vulcan's Orbit, were founded on the rough observations of a French physician, Lescarbault. Yet M. Liais asserts that he observed the Sun at the identical time of Lescarbault's observations, and with *much better instruments*, and he is positive that no "black spot" was visible. This is one instance of many. But granting that "two round black spots" were really seen by Dr. Watson for a few moments, it may have been the *transient* interposition of objects comparatively *near the earth*—stationary and dense fragments of cloud, (and he says he saw the Sun through clouds)—large and distant birds in poise, or even meteorites, moving for a few moments in the line of sight to the Sun. But conjecture is useless, and so I desist.

C. W. Pritchett.

Glasgow, Mo., March 11, 1885.

SUN AND PLANETS FOR APRIL, 1885.

W. DAWSON, SPICELAND, IND.

Having passed the Vernal Equinox, the starting point of R. A., the Sun begins another course of the 24-hour circle; and on April 1st has gone just three-fourths through the first hour, and has attained a north declination of 4° 48'; when it rises six hours and sixteen minutes before southing, and sets six hours sixteen minutes after—making the day twelve hours thirty-two minutes long—in 40° N. latitude. At the end of April the Sun's R. A. will be 2h. 32m.; and declination 14° 58' N. At this declination the Sun (or any other celestial body) rises 6h. 52m. before southing, and sets as much after; making its time above the horizon 13h. 44m.

The eclipse of March 16th was partially observed here. It began at 11:04. S. M. T., or 10:45 R. R. Time, 90th Meridian. In two or three minutes it made a grandly curious notch in the west side of the Sun. Mountain protuberances on the Moon's edge were quite prominent. For ten or fifteen minutes it seemed to move almost directly eastward as if the eclipse would be nearly, or quite annular here; but it passed upward and northward and left the Sun's edge a little eastward of the north point, about two or three minutes before two o'clock, but the last contact was obscured by clouds. At 1:55 there was quite a visible notch, but it was entirely gone at 1:59. Clouds prevented seeing a transit of the Moon's edge over a good sized spot near the lower edge of the Sun; but small spot just to the left was hid at 11:33. Contact with the large spot above centre occurred at 11:44; and a small one about half way from this to the lower edge, twenty seconds earlier. The next smaller spot at upper end of the group was in contact at 11:48. Dense clouds soon came over and prevailed until 12:50, when it thinned just enough to get a good view without shade glass. The black Moon now appeared in the *upper side* of the Sun, obscuring near half its diameter. It soon rose above the large group of spots, and in a short time everything was again hid by clouds; and the eclipse not seen much more; though enough to get nearly the time of ending—to learn that it lasted two hours and about fifty-four minutes.

The planet Mercury will be "Evening Star" all the fore part of April—coming to greatest elongation east (19° 26') in the morning of the 8th, when its declination is nearly 17° N., which at this time of year is a position quite favorable for observation. It will set several degrees north of the sun-set point. Venus is still Morning Star, but too near the Sun to be well seen.

Mars is also Morning Star and near Venus, hence of no interest for observation. Jupiter is still a very prominent evening star high up in the eastern sky; southing at 9:14 P. M. on the 1st. and setting at 4:00 o'clock next morning. Its proximity to Regulus, in the south end of the Sickle gives a beauty to both.

... in the western sky, setting near midnight on the 1st of April, and

at 10:00 P. M. on the 31st. It is some distance east of Aldebaran in the Hyades group, and may be readily known by its bright silvery luster. The third magnitude star southeast of it is Zeta Tauri, and the brighter one north Beta Tauri. Now is the time to get a last look at the widest phase of its rings for nearly fifteen years.

RECENT ASTRONOMICAL DISCOVERIES.

A cable message from Dr. Krueger, received on March 7th, announces the discovery of an asteroid by Borelli.

March 6d. 8h. 45m. 36s. Greenwich M. T.
R. A. 11h. 6m. 13.5s. Decl. Plus 7° 9′ 17″
Daily Motion in R. A. —48s.; in Decl. plus 9′.
Eleventh magnitude.

A cable message from Dr. Krueger, received on March 10th, announces the probable discovery of Pogson's lost planet, by Dr. Palisa.

March 9d. 8h. 28m. 45s. Greenwich M. T.
R. A. 6h. 44m. 41.7s. Decl. Plus 28° 10′ 1″

A cable message from Dr. Copeland, at Dun Echt, received March 14th, announces the observation of a suspicious object by Dr. Gautier (of Geneva), which may be a return of Comet 1867 II. (Temple). A request was made for observations by American astronomers, and the following finding ephemeris was included in the message:

Gr. Midnight.		R. A. H.	M.	S.	Decl. °	′	Light.
March	13	12	11	40	Plus 17	45	0.20
	17	12	8	28	18	5	
	21	12	5	8	18	24	
	24	12	1	48	Plus 18	38	0.21

—*Science Observer Special Circular No. 56.*

ARCHÆOLOGY.

PREHISTORIC MAN IN EGYPT AND SYRIA.

A gala Meeting was held by the Victoria Philosophical Institute of London some time since at which its members gave a worthy welcome to Vice-Chancellor Dawson, C.M.G., of McGill University, Montreal, at whose instance the British

Association visited Canada this year. The Society of Arts kindly lent its premises for the occasion, and its great theatre was crowded in every part long before the hour of meeting. The chair was taken by Sir H. Barkly, G.C.M.G., K.C.B., F.R.S.,—who after the new members had been announced by Captain F. Petrie, the secretary—welcomed Dr. Dawson amid loud applause, and asked him to deliver his address: It was on "Prehistoric Man in Egypt and Syria," and was illustrated by large diagrams, also flint implements and bones collected by Dr. Dawson himself on the spot during his winter tour in the east; Professor Boyd-Dawkins, F.R.S., kindly assisted in the classification of the bones. In dealing with his subject, Dr. Dawson remarked that, great interest attaches to any remains which, in countries historically so old, may indicate the residence of man before the dawn of history. In Egypt, nodules of flint are very abundant in the Eocene limestones, and, where these have been wasted away, remain on the surface. In many places there is good evidence that the flint thus to be found everywhere has been, and still is, used for the manufacture of flakes, knives and other implements. These, as is well known, were used for many purposes by the ancient Egyptians, and in modern times gun-flints and strike-lights still continue to be made. The *débris* of worked flints found on the surface is thus of little value as an indication of any flint-folk preceding the old Egyptians. It would be otherwise if flint implements could be found in the older gravels of the country. Some of these are of Pleistocene age, and belong to a period of partial submergence of the Nile Valley. Flint implements had been alleged to be found in these gravels, but there seemed to be no good evidence to prove that they are other than the chips broken by mechanical violence in the removal of the gravel by torrential action. In the Lebanon, numerous caverns exist. These were divided into two classes, with reference to their origin; some being water caves or tunnels of subterranean rivers, others sea caves, excavated by the waves when the country was at a lower level than at present. Both kinds have been occupied by man, and some of them undoubtedly at a time anterior to the Phœnician occupation of the country, and even at a time when the animal inhabitants and geographical features of the region were different from those of the present day. They were thus of various ages, ranging from the post-Glacial or Antediluvian period to the time of the Phœnician occupation. Dr. Dawson then remarked that many geologists in these days had an aversion to using the word "Antidiluvian," on account of the nature of the work which, in years now gone by, unlearned people had attributed to the Flood described in Scripture, but as the aversion to the use of that word was, he thought, not called for in these days, he hoped it would pass away.

Speaking as a geologist, from a purely geological point of view, and from a thorough examination of the country around, there was no doubt but what there was conclusive evidence that between the time of the first occupation of these caves by men—and they were men of a splendid physique—and the appearance of the early Phœnician inhabitants of the land, there had been a vast submergence of land, and a great catastrophe, aye, a stupendous one, in which even the Mediterranean had been altered from a small sea to its present size. In illustra-

tion of this, the caverns at the Pass of Nahr-el-Kelb and at Ant Elias were described in some detail, and also, in connection with these, the occurrence of flint implements on the surface of modern sandstones at the Cape or Ras near Beyrout; these last were probably of much less antiquity than those of the more ancient caverns. A discussion ensued, which was taken part in by a number of distinguished Fellows of the Royal Society, including Sir H. Barkly, F.R.S., Professors Wiltshire, F.R.S., Warrington Smyth, F.R.S., Rupert Jones, F.R.S.; Colonel Herschel, F.R.S., the talented son of the late Sir John Herschel; Dr. Rae, F.R.S., the Arctic explorer; Dr. Dawson, F.R.S.; Mr. D. Howard, the Vice-President of the Chemical Institute, and other geologists. The meeting afterwards adjourned to the Museum whese refreshments were served.

THE USE OF COPPER IMPLEMENTS BY THE AMERICAN ABORIGINES.

PROFESSOR WRIGHT.

The interest with which we contemplate the work of the mound-builders is greatly enhanced by reflection upon the rudeness of their tools and the simplicity of their mechanical contrivances. There is no evidence that the original inhabitants of America had any knowledge of iron, or that they knew how to manufacture bronze. Ornaments of silver and gold were abundant in Mexico and South America, but neither of these valuable metals is available for tools. Copper was distributed over the whole of North America; and, while used extensively for ornaments, was only occasionally manufactured into implements; and, indeed, copper is not hard enough either to make a good edged-tool or a hammer. Hence at the time of its discovery by Columbus, America was still in the stone age, and stone implements everywhere marked the haunts of the aboriginal inhabitants; and the implements found in the most elaborate earthworks of the mound-builders are not superior in design or workmanship to those which mark the camping-places of the roving tribes.

Copper was, as we have said, widely disseminated among the aborigines of America, being found in almost every place where there are any prehistoric remains, from the lake to the Gulf of Mexico, and from the Atlantic Coast to the Mississippi and beyond. It was occasionally wrought into axes, chisels, gravers, knives, arrow-points and spears, but its principal use was for ornaments. Prof. Putnam has shown that the ancient copper implements of the United States have all been manufactured by hammering, proving that the natives did not under- the art of casting. In South America, however, copper has been found contain-taining the impress of the molds in which it was cast. The copper bracelets and beads so often found in the mounds were made from thin plates of the metal which had been hammered into shape and then bent over a string.

The source from which copper implements and ornaments have been derived

is, without much doubt, on the northern peninsula of Michigan, near where mining is carried on so extensively at the present time. Native copper is occasionally found in the valley of the Connecticut River and in New Jersey, but in quantities too small to have furnished even the supply which we know to have been in possession of the aborigines of New England. On Keweenaw Point, however, in Northern Michigan, not only is there an endless amount of native pure copper which savages could use without melting, but there are numberless excavations made by natives in searching for the metal before historic times.

This portion of Michigan lay in the track of the great ice-movement which characterized the glacial period. By this means boulders were transported from this region as far as the southern parts of Ohio, Indiana, and Illinois. I have, indeed, found boulders (though none containing copper) from the vicinity of these mines which had been carried by the ice to the Kentucky hills, a few miles south of Cincinnati. It is not surprising, therefore, that occasionally masses of this copper should be found in connection with the gigantic boulders which had been transported by ice to the vicinity of the mounds in the Ohio Valley. A piece of Lake Superior copper weighing five or six pounds was found by Prof. Brainard, of Cleveland, in the glacial deposits of Medina County, O. Dr. John Locke, of Cincinnati, reports in his possession "a flattened piece of copper, weighing several pounds, which was found in the earthworks at Colerain, Hamilton County, O., having a spot of silver as large as a pea forming part of the mass." The presence of silver in such form is pretty positive evidence that the mineral came from Lake Superior, as it is not known to exist in this condition in any other mines.

Considering the rude tools with which the prehistoric miners of Northern Michigan were compelled to work, their operations were really very surprising. Their mauls were nothing but pebbles from the beach, grooved for withes, which they used as handles. With these rude implements they broke away the rocky portion of the vein containing the copper, and dug trenches, in some places ten feet deep, and extending a long distance. Occasionally they encountered a mass of copper too large for them to manage; and after working upon it ineffectually for a long time, left it surrounded with their tools and crude mechanical contrivances, to tell the story of their disappointment.

Near Copper Falls, according to Col. Whittlesey, there was discovered in 1854, a prehistoric trench, dug in the solid rock to a depth of ten feet and following the copper veins for thirty feet. From the bottom of the trench in one place a flat piece of copper, from five to eight inches thick, was found to project upwards for eighteen inches, the granite upon each side having been removed by stone hammers to that depth. The upper edge of the copper "had been beaten by the stone mauls so severely that a lip, or projecting rim had been formed, which is bent downward over the sides. A large number of broken mauls were found in the place, and around it on the surface." It is not surprising that the efforts of these ancient miners were ineffectual in the present instance, as this mass of copper proved to be about nine feet in length, being,

therefore, still imbedded, and when they left it seven feet below the rocky bottom of their trench. There are neither marks of a cutting tool nor of fire upon these masses of copper.

At the Minnesota mine in the vicinity of Ontonagon River, a group of rude ancient trenches shows the position of the copper vein for more than two miles, and the excavations are some of thirty feet in depth. In one of these there was found when first discovered, in 1847, a detached mass of copper weighing nearly eight tons, which lay "upon a cob-work of round logs, or skids, six to eight inches in diameter, the ends of which showed plainly the stroke of a small ax or cutting-tool, about two and a half inches wide." These skids were of oak, and, on drying, shrank and cracked as water-soaked timber which has been long buried, is sure to do, and possessed little strength. "The mass of copper had been raised several feet on the timbers by means of wedges." "Its upper surface and edges were beaten and pounded smooth, all the irregularities taken off, and around the outside a rim or lip was formed, bending downwards." Charcoal and ashes were found in all these trenches. One of the stone mauls from this vicinity weighed thirty-six pounds, and was provided with a double groove, being, doubtless, intended to be used by two men.

In one of the pits a rude ladder was found, formed of an oak tree trimmed so as to leave the stumps of the branches projecting, on which men could readily descend or ascend to or from their work. Wooden levers were also found among the rubbish, preserved by the water, which covered them continually. On the edge of the excavation in which the mass of copper described was found, there stood an aged hemlock, the roots of which extended across the ditch. I (Colonel Whittlesey) counted the rings of annual growth on its stump, and found them to be 290. Mr. Knapp mentions another tree which had 395. The fallen and decayed trunks of trees of a previous generation were seen lying across the pits.

According to Mr. Foster, the number of ancient hammers taken from these excavations alone exceed ten cart-loads.

"In cleaning out one of these pits the workmen came upon the remains of a wooden bowl, which, it was inferred from the splintery fragments of rock imbedded in the rim, must have been employed in baling out water." From the uniformity with which marks of fire are found in these trenches, it is plausibly inferred that the rock vein was heated, and water dashed upon it to destroy its cohesion, and make it crumble more easily under the blows of the rude mauls wielded by the ancient miners. "This method was practiced by civilized nations before the invention of gunpowder, and is even at this day in the mining districts of the Hartz and Altenberg." At Isle Royale, on Lake Michigan, some of the ancient mining pits are fifty feet in depth, and according to Foster and Whitney, there is scarcely a productive vein in all the copper region that does not give evidence of having been worked in prehistoric times.—*Chicago Advance.*

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Feb. 20th to 28th.	Mar. 1st to 10th.	Mar. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	10.	25.	14.	16.
Max	53.	70.	70.	64.
Min. and Max	31.	48.	42.	40.
Range	43.	45.	56.	45.
TRI-DAILY OBSERVATIONS.				
7 a. m.	18 6	31.2	33.0	27.6
2 p. m.	33.8	54.2	52.1	46.7
9 p. m.	25.1	36.6	39.6	33.8
Mean	25.6	40.7	41.6	36.0
RELATIVE HUMIDITY.				
7 a. m.	..	..	..	..
2 p. m.	..	..	..	..
9 p. m.	..	..	..	..
Mean	..	..	..	..
PRESSURE AS OBSERVED.				
7 a. m.	29.263	29.246	29.062	29.181
2 p. m.	29.163	29.116	29.053	29.107
9 p. m.	29.173	29.127	29.049	29.116
Mean	29.196	29.163	29.055	29.135
MILES PER HOUR OF WIND.				
7 a. m.	..	..	..	..
2 p. m.	..	..	..	..
9 p. m.	..	..	..	..
Total miles	1550	2967	3141	7658
CLOUDING BY TENTHS.				
7 a. m.	5.6	4.6	5.8	5.3
2 p. m.	6.1	4.9	4.3	5.1
9 p. m.	5.7	1.7	5.1	4.2
RAIN.				
Inches	5.0	0.58	.20	1.28

The last ten days of February were somewhat milder than the second decade, but it remained quite wintry through February, and the mean temperature was only 20°. There have been no days, since February 20th, when the temperature fell below 10°, and since March 1st the lowest temperature was 14°. Very little rain or snow has fallen. The heaviest snowfall of the winter occurred February 23d when about six inches fell. Northerly winds have been prevalent but the total wind travel has been rather below the average at this season.

:ther the season is backward, and a cold, late spring seems likely to be
› a long severe winter.

ENGINEERING.

THE NICARAGUAN CANAL.

J. W. MILLER.

Just at this time, when attention is directed to the Central American war, perhaps the attitude of the national government may be better understood and its importance to us more fully realized after reading the following relating to the proposed Nicaraguan Canal, written by J. W. Miller, superintendent of the St. Louis, Ft. Scott & Wichita Railroad Company. Mr. Miller was in the naval service, and twice made survey of the Nicaraguan and Panama routes, prior to his journey round the world with Gen. Grant. A man of unusual intelligence and culture, with powers of observation that make his notes of special value at this time, from which liberal extracts are taken:

Few persons seem at all aware how simple an engineering feat the canal problem present ot Nicaragua. The summit level is the lake, only one hundred feet above tide-water. From its southeastern end flows the San Juan River, which can be used for more than sixty miles of its length, leaving only forty-five miles for a canal. This canal runs through a low alluvial land, no excavations are necessary, no tunnels have to be bored, while the last seven miles before reaching the Atlantic is simply ditch work through the swamps and lagoons, where there is already an average of seven feet of water.

To return to the upper part of the San Juan. Sixty miles are to be utilized by damming the stream. This idea has been ridiculed by various engineers on the score that freshets would wash away the dams—a natural though hasty conclusion to be reached by any one conversant with the immense destructive force produced by tropical water rainfalls. But note that at Nicaragua alone freshets do not occur, for the lake is in an immense basin, one hundred miles long by thirty broad, into which the old surrounding country is drained, the river San Juan being simply an outlet, never rising more than six feet during the entire year. Contrast this gradual rise with the "cataract" which would be formed in the Chagres River if the Panama Canal were built. Slack water navigation is, therefore, feasible on the San Juan, and feasible nowhere else upon the Isthmus, for at no other point is there a constant level reservoir. "But," we are told, "the locks will necessarily be of such size that traffic will be suspended through the time taken to fill and discharge them, and ships endangered by the breaking of flood-gates." Mr. Menocal has gotten over these objections in his ingenious method of admitting and discharging the water of the locks. If not, Captain Eads' railway can be used in connection with the canal. None of the short canals around the dams are to be more than two miles long, and marine railways

might prove less expensive and overcome the ten-foot "lift" from lower to upper level with greater ease than a lock.

Next, let us look at the Pacific section. It is a generally received idea that the Cordilleras of the isthmus extend in one unbroken barrier from Mexico to South America. Fortunately, in Nicaragua they trend to the eastward of the lake, ending on its western side in the volcano Monbachio, near Granada. From Granada to Rivas the country is a succession of hills, nowhere rising to an altitude of more than 1,000 feet, and sinking to an elevation of less than 130 feet above the lake at the point where the canal crosses the divide. In other words the "cut" to be made is 127 feet, plus the depth of the canal. The divide is six miles from the lake and about ten from Brito, the Pacific terminus. To lock down this distance is a simple matter; or, again, let Mr. Eads give us a double track railway.

When the expedition sailed for Nicaragua the great problem to be solved was the discovery of a pass through this western section. More than three months were passed in surveying tentative lines, and when two were found with profiles of less than 130 feet, we could scarcely believe our levels were correct. They were gone over again, one of the routes being only seventy-eight feet at its summit.

When the expedition returned to the United States the advocates of other routes, unable to find any fault in the Nicaraguan liue, immediately set about to discover imaginary objections. It was bruited abroad that there were no harbors at either terminus. Let us see if this is true.

Graytown is in reality a better harbor than ever. Thirty years ago the San Juan and its tributaries from Costa Rica (which enters below the canal) brought down vast quantities of sand and detritus. The volcanic sand, being of light specific gravity, had the effect of making a shift bar across the mouth of the river. Eventually this bar became so extensive that the stream sought an exit further southward, at Colorado Bay, where it now discharges. There are to-day fourteen feet of water inside of the bar, and outside of it the ocean bed is hard and stable, the coast current having set the whole amount of sand back against the outer shore, which is now covered with trees and bushes. The absence of the silt-bearing river is, therefore, a cause for congratulation; and a channel once dug through Greytown Bar, the harbor is an accomplished and enduring fact. All tropical rivers are a curse to a harbor. There is not the slighest chance that the San Juan will ever return to its original bed, the history of its change of course and the configuration of the land, both going to prove that its tendency is to work south.

It must be granted that there is no good harbor at Brito, the Pacific terminus, but there is an excellent one a few miles to the southward, which would afford ample refuge for incoming vessels. Brito, however, is susceptible of very great improvement at moderate cost; a tall cliff protects the roadstead from northers, and the bottom land of the mouth of Rio Grande (which empties at the base of the cliff) can be easily excavated.

That the Nicaragua route is nearer the United States than others is self-evident, but the gain in distance between the Pacific and Atlantic ports is not the only advantage; for, granted that much of the carrying trade will still be done by sailing vessels, the "doldrum" weather of Panama Bay and its neighborhood will be avoided, and a gain in time of two or three weeks made by ships using the Nicaraguan Canal.

The last reason for advocating the Nicaragua route, "that it presents the advantage of a unique harbor between the two oceans," is in itself a sufficient argument to overcome any minor objections. But Lake Nicaragua is more than a harbor. It is a harbor of purest fresh water; a sheet of water surrounded by land capable of producing every variety of provisions necessary for victualling ships; the plains near the city of Rivas are rich in tropical fruits, and the table-lands produce corn, chocolate and sugar, while the cereals of the temperate zone grow upon the mountain sides of eastern Nicaragua.

On the return of the expedition, much time and labor was given to working up the various journals and levels, and from the figures obtained the exact cost, founded on the price of labor then current, necessary to construct a canal was obtained. To this cost was added the usual 25 per cent for contingencies, and subsequently a still greater amount was added, on the supposition that rock might be encountered two feet below the present profile. The estimates may, therefore, be considered as above rather than below the actual cost, but with all these additions, the Nicaraguan Canal will be $20,000,000 cheaper than any other.—*Kansas City Journal.*

MEDICINE AND HYGIENE.

THE ORIGIN AND SPREAD OF CHOLERA.

B. F. JONES.

I will present an article which appeared in "Bradstreet's," a New York "journal of trade, finance, and public economy," March 21, 1885, upon the subject of water supply in its relation to cholera, which contains as much common sense, it seems to me, as it is possible to get into the space occupied and which will be read with interest by the people of Kansas City. The author is Colonel William Ludlow, chief engineer of the Philadelphia water-works. His reference to the fact that the most common vehicle for the transmission of cholera is drinking-water which has been contaminated with cholera discharges, is a source of comfort so far as such discharges are likely to affect our water-supply. It is a well known fact that there are no sewers above us on the classic stream from which our supply is taken to cause the least apprehension—but this article cannot be of

the least comfort to those who will persist in the use of water from wells and cisterns which are most likely to have seeps from sewers, cess-pools, and the like, in which these deathly cholera discharges have been deposited:

"The important question of water supply is attracting marked attention all over the country, and numerous communities, large and small, hitherto unsatisfactorliy provided for are taking steps to procure charters and raise the necessary funds for new constructions. The rapid growth and practical application of sanitary knowledge of late years has largely contributed to the result, but in especial has the public sense of the importance of a wholesome water supply been quickened and aroused to action by a widespread anticipation of an invasion by Asiatic cholera.

"It is in accordance with all past experience that this plague will reach us in the year following its appearance in western Europe, but whether it comes or not we have had ample warning, and furthermore are in possession of the requisite knowledge of how to meet it and forbid it to do more than effect a landing.

"The cholera is purely a filth disease, which alike in its home amid the ignorance and squalor of Bengal or isolated in hospitals under the surveillance of the most skilled physicians, claims as victims more than 50 per cent of those reached by its insidious attack. But while it thus baffles all medical skill and arouses the bitterest contention among those who seek to explore the mystery of its genesis, the practical methods of dealing with it are well understood and can be rendered entirely effective. The individual victim must take his half chance, but the community can be protected.

"It has been well determined that only in the alimentary canal is the specific poison of cholera capable of its deadly work in man. It is true that infected clothing will transport it, but unless the germ reach its appointed place in the human intestines no harm can result. The healthy stomach even is proof against it, so that whether at home or on its pestilential journeyings experience has proved that the common vehicle of its transmission from victim to victim is drinking-water which has been previously contaminated with cholera discharges.

"The moral of this is evident. The first care of those who bear the responsiblity of protecting the public health is to see to it that the most minute precautions shall be taken to guard the water supply from possible contamination. It is not enough that the time has gone by when a well sunk in earth saturated with sewage or surface drainage can be permitted to spread its contagion. Attention must be given to this, it is true, since the ignorance of people is only supassed by their obstinacy, but the health officer or local official who fails to close a source of such deadly peril to the community should himself be buried alive in it. Cisterns and reservoirs too, must be thoroughly cleansed and purified, drains explored, opened, repaired and ventilated; sewer connections examined and trapped; care taken that the water to be used for dietary purposes has no possible connection with that used for flushing. These details are obvious and need not be enlarged upon.

"But the broader field remains to be explored. I will venture to say that

at the present time there are very few water supplies in the land into which more or less water-closet or similar drainage does not find its way to a greater or less extent.

"The entire region drained by the supply should be gone over as though with a fine-toothed comb, and every spot where human pollution could by direct discharge or indirect filtration reach the drinking-water, should be at once and permanently eradicated. This will in many cases arouse opposition and contumacy, for it is impossible, unless one has actually undertaken the task, to realize the brutal selfishness of those who, unendangered themselves, will claim the right to continue the poisoning of their neighbors. Were they to do so at close quarters a shotgun would be a proper argument, but since their premises are beyond the range of a rifle they will persist in imperiling the lives of others unless the strong hand of the law be laid upon them.

"These considerations, you will observe, apply as well to new sources of supply as to those already existing.

"It would be desirable to supplement this minute exploration of physical features by analytical and microscopic investigations. While chemistry has its limitations and cannot positively assign the causes of certain components of water supply and totally fails to disclose the existence of diseased germs it is extremely useful as a guide, and especially in confirming the results of local examinations. The field of microbiology in connection with water supply is as yet hardly entered upon, but its application can not fail to prove of the very highest value and furnish indications beyond the possibilities of other methods.

"It is needless to say that both chemist and microscopist should be competent to do their work. Nothing is more misleading and worthless than the report of the ignoramus or the charlatan, and the world, even the scientific world, is not at present composed of instructed and conscienscious men exclusively.

"With the general supply thoroughly guarded, no spread of pestilence need be feared. Should individual cases occur they can be strictly localized and contagion exterminated; but while the presence of cholera need occasion no panic, it must be remembered that nothing but unremitting vigilance and thorough preparation can avail to suppress the foul visitor or prevent his swarming and invisble myrimidons from penetrating to our homes and fastening upon their prey."

I think the careful perusal of the above will be a thorough vindication of the senseless idea that our water supply will induce cholera.—*Kansas City Times.*

PREVENTION OF CHOLERA.—THE STATE BOARDS OF HEALTH REPORT.

The report of the committee of the State Boards of Health upon the "Practical Work Required for the Prevention of Cholera in this Country" embodies the recommendations made to the United States and Canadian Governments and to the country at large. The recommendations were drafted by a committee

composed of Henry P. Baker, Secretary of the Michigan Board of Health; H. P. Wolcott, Chairman of the Massachusetts Department; S. S. Herrick, Secretary of the Louisiana Board; Peter H. Bryce, Secretary of the Provincial Board of Ontario; J. H. Rauch, Secretary of the Illinois Board.

There are three essential factors to the prevalence of cholera in this country as an epidemic: (1) The importation of the disease by means of ships more or less directly from its only place of origin in India; (2) local unsanitary conditions favorable to the reception and development of the disease; (2) persons sick with the disease in some of its stages, or things infected by such sick persons, to carry it from place to place. These three factors naturally suggest the methods of combating the disease, for which there is needed practical work, international, national and inter-State, State and local. So far as relates to State and local boards of health, their organization and activities are greater than ever before; but it must be admitted that after cholera has been introduced into a country, inland quarantines are not easily and sucessfully maintained, although efforts in this direction are even then advisable. In view of the threatened introduction of cholera into this country during the coming year, and the consequent immense waste of life and property values through derangements of commerce, trade and productive industries, it is the sense of this conference that the General Government should maintain such a national health service as shall, by rigid inspection at the port of embarkation, question the freedom from disease and infection of all persons and things from infected districts; and shall secure the surveillance of such persons and things while on shipboard, and, when necessary, detention at quarantine stations on this side for treatment and disinfection.

In view of the present threatening aspect of Asiatic cholera, and the constant danger from other communicable diseases occurring at foreign ports having commercial relations with the United States, we urge upon Congress to provide for the appointment and maintenance at all such foreign ports where cholera, yellow fever, plague, small-pox, or scarlet fever exist or are liable to exist, of medical officers of health, the same being either accredited consuls or attached to the consulates. The duties of these officers shall be: To give notice, by telegraph when practicable, of the existence or appearance of any of the above named diseases to some constituted authority in this country; to give notice of the departure of any vessel known or suspected to be infected for any port in the United States; and, whenever requested by the master of any vessel about to load or leave for this country, to inspect thoroughly such vessel in all her parts, and also her cargo, her crew and passengers; to use such cleansing and disinfection as he may deem necessary, and to satisfy himself that all persons about to sail are free from dangerous communicable diseases, are not recently from infected places, and are properly protected from small pox, giving to her commander a certificate of the inspection and of all precautionary measures taken. And it shall be the duty of the central authority in this country to transmit promptly intelligence of the existence of the above-mentioned diseases at foreign ports and places, and of the

departure of dangerous vessels for the United States and Canada, to all State and local health authorities in the country which may be interested in the same.

We further recommend, in case of those foreign ports which have no consular agents in this country, or no telegraphic communication with this country, and which are liable to transmit pestilence through commercial intercourse, that one or more medical officers be chosen to visit such ports as often as may be deemed necessary by the central health authority in this country, so as to give trustworthy information of the health and sanitary condition of those places.

Inasmuch as the Dominion of Canada is equally interested with the United States in protecting itself and the United States from the importation of dangerous diseases, we suggest that Congress take such measures as will bring about concerted action with the Dominion and the British Government by which the consuls of this country or of England at foreign ports shall examine and take such action as they may deem effective, and notify the authorities of such government as has authority over any port to which any ship may sail in the United States or Canada, in order that such government may be in a position to take effective measures against the importation of these diseases. We are gratified that the authorities of the Dominion of Canada and of the Province of Ontario have taken active steps toward protecting the people of Canada and indirectly those of the United States, by the adoption of extensive quarantine regulations. We feel, however, that with respect to those regulations regarding the landing of passengers from the mail steamers along the St. Lawrence, etc., further special regulations for the thorough disinfection of the baggage and effects of all passengers, cabin or steerage, as come from infected ports and places, should be carried out in a manner similar to that recommended by the National Board of Health. Believing that the importation of cholera into this country has usually attended the presence of immigrants from infected countries, we therefore recommend that all such immigrants be prevented from landing at our ports until such time as the danger of the introduction of cholera by them shall have passed.

The inspection and quarantine service inaugurated by the National Board of Health, and set forth in the paper by Dr. Smart before this Conference, but which system is now inoperative for want of an appropriation by Congress, meets with our cordial approval. To enable these protective measures to be carried out, we recommend that Congress be urged in the strongest terms to legislate on this subject at an early date in its coming session, and to appropriate such funds as may be needful. The expenses incident to the work which has to be performed at foreign ports, and the establishment of refuge stations at points on our coast for the detention and treatment of infected vessels arriving from foreign ports, should undoubtedly be borne by the National Government, and not by individual States or municipalities, for the benefits accruing therefrom are general and not restricted to localities, although some ports and cities on the coast may have a more immediate interest in the matter than others in the interior It is probably, however, that this national protective work may not be sufficient.

It will undoubtedly delay and lessen the chances of invasion, but it may not

prevent invasion; the poison of the disease is subtle, and may effect an entrance into the country at some unguarded point. The funds necessary to the stamping out of the disease in a particular locality, and to the prevention of its spread to other localities might in some instances be borne by the municipality or State affected; but should the disease occur in a locality which has failed or is unable to make provision for the occurrence, its spread to other cities and States would be imminent. The want of means at the infected point would be disastrous to many others. Congress has recognized the necessity for aid to State and local boards of health under similar conditions in the case of yellow-fever. In 1879 the sum of $500,000 was appropriated and placed at the disposal of the National Board of Health; and the records show that of this sum $160,000 was employed in combating the epidemic of that year. We therefore recommend that the influence of this Conference be used with the view of having appropriated by the National Legislature the sum of $500,000, to be used, or as much thereof as may be needful, in case of a cholera invasion, in stamping out the disease from the infected localities, and in preventing its spread from state to state.

The removal of local unsanitary conditions favorable to the development of cholera is the especial work of state and local boards of health. Much has been done already in some states, but much remains which should receive immediate attention. Where it can be done, State Sanitary Inspectors should be appointed to visit all the towns and cities specially liable to the disease, to counsel with the local authorities as to the best methods of prevention. This work should be vigorously prosecuted before the disease reaches our shores.

The cause of cholera is contained in the discharges of persons affected by the disease, or in things infected by such discharges. Should the disease reach our shores, the first case, and after this the first case which reaches any given community, should be strictly isolated; all infected material from those and from any subsequent casses shonld be destroyed in such manner as to stamp out the disease. Intelligent sanitary precautions beforehand and scientific disinfection and treatment in the presence of the disease should take the place of necessary cruelties in case of a panic. In case any city or town is infected, the same principles of isolation should in general be applied to the city as to the infected individual. Intercourse with other places and cities should be under sanitary supervision, substantially as set forth in the rules and regulations of the National Board of Health, respecting the inspection of travelers, disinfection of effects, vehicles, etc.

Health officers and inspectors appointed by state or provincial boards of health should, in addition to other sanitary work, see that the localities have set apart, erected, or planned to be set apart or erected, structures which shall possess the sanitary requirements of an isolation hospital. But as regards all necessary work by local boards of health, most state and provincial boards of health have printed and issued documents which give ample instructions.

BOOK NOTICES.

CREATOR AND CREATION: By Laurens P. Hickock, D. D., LL. D. Octavo, pp. 360. Ivison, Blakeman, Taylor & Co., New York. For sale by Ginn, Heath & Co., Boston.

This is an intensely philosophical treatise upon the knowledge in the reason of God and his work, and is an attempt to present the physical portion of a philosophy which shall be able, with the metaphysical portion already presented in rational psychology, to harmonize the observed phenomena of nature and the faith of theists so that both shall be found to be essential parts of a unified spiritual scheme competent to silence all skeptical cavilling at theology. In the words of the author, "After a critical examination of the leading theories of modern philosophy, exposing the main point in which with most there is an utter, and in the best a partial, deficiency, and therein opening the sure process to the knowledge of an absolute Creator, the Creation is itself speculatively contemplated in its essential forces and those determined in their necessary connections."

The argument of the work is that these essential forces have their determined connections in all the mechanism of inorganic nature, and then a life-power is contemplated as superior by the Creator, which uses these essential mechanical forces in spontaneously upbuilding about itself, and for its own ends, the varied organic structures of the vegetable and animal kingdoms; when a contemplated endowment of animal life sentient life with reason introduces man in the image of the Creator and crowns the creative work with a spiritual kingdom in humanity which has dominion over all.

The following is the author's general method: First, to determine the extent of knowledge within experience; to recognize reason as competent to carry our knowledge beyond experience and then, by reason, to attain the sure knowledge of a being who may be an Absolute Creator.

Second, to show that no one space and one time can be determined in common for all, without a knowledge of fixed force in place, and passing force in period, to contemplate how such distinguishable forces may be originated, and by their multiplication and interaction a material universe may be consummated, and then how the superinduction of a life-power may build up all the organisms of the vegetable and animal kingdoms, and the gift of reason may elevate the animal to the human.

The work is divided into two parts, I—Knowledge of a Creator, II—Knowledge of Creation. The first is divided into three chapters entitled: Knowledge Restricted to that which is Gained in Experience; Reason Competent to Know an Outer Creation; Reason Knows the Creator. The second is also divided in three chapters, viz.: Space and Time; Force; Life. Force is considered under three divisions; Antagonistic force; Diremptive force; Revolving force. Under

the head of Life are discussed The Reign of Life in the Vegetable Kingdom; Reign of Sense in the Animal Kingdom; the Reign of Reason in humanity.

It will be seen by this meagre outline of the scope of the work that the execution of the plan necessarily carries the reader to the highest sphere of speculative philosophy, yet he will find that "by the use of reason as a distinct organ of transcendental knowledge we may consistently attempt to attain a knowledge of the Creator; following which we may also consistently seek to know the work of Creation in its incipiency, progress and consummation."

We commend it to all who desire to obtain a view of the subject from a higher standpoint and from a more comprehensive platform than are ordinarily furnished by thinkers of the merely materialistic school.

CHAPTERS ON EVOLUTION: By Andrew Wilson, Ph. D., F. L. S., Etc. With 259 illustrations. Octavo, pp. 383. G. P. Putnam's Sons, N. Y. For sale by M. H. Dickinson; $2.50.

This is not a new work, but it probably presents the facts and arguments of evolution as fully and fairly as any that has been published. Commencing with the almost simultaneous promulgations of the theory, worked out at opposite points on the globe, by Darwin and Wallace in 1858, he states the problem concisely and clearly, following the statement with consequent and logically arranged chapters upon the study of biology, the constitution of the animal and plant kingdoms, protoplasm; the evidence in favor of the theory from rudimentary organs; from the tails, limbs and lungs of animals; the evidence furnished by the science of likenesses; from missing links, from development in the earlier stages in the life history of animals, in the life histories of star fishes and crustaceans, and from the development of mollusks, anphibians, etc.; the evidence for the life-histories of insects; from the constitution of colonial or compound animals; from the fertilization of flowers; from degeneration; and finally a chapter on geology and evolution.

The whole is bountifully illustrated with wood cuts, while the style is attractive and lucid. Any reader who wishes to find the whole subject fully treated in one volume need go no further than this.

THE APPROACHING END OF THE AGE: By H. Grattan Guiness. Sixth edition. Octavo, pp. 776. A. C. Armstrong & Son, New York, 1884. For sale by M. H. Dickinson, $2.50.

The full title of this work is "The Approaching End of the Age, Viewed in the Light of History, Prophecy and Science," and its author, who is Director of the East London Institute for Home and Foreign Missions, has devoted many years of patient and laborious research to its preparation. Its object is to prove that the day of Christ is at hand, or, to use the language of the author, "that the time for evangelizing the nations and gathering in the church of the first-born

is speedily to expire—that the long day of grace to the Gentiles is all but over, and that apostate Christendom, so long spared by the goodness of God, is soon to be cut off by his righteous severity—that the mystery of God is all but finished and his manifested rule about to be inaugurated—that the closing Armageddon conflict is at hand and the complete overthrow of the confederated hosts of evil; that scarcely a single prophecy in the whole Bible, relating to events prior to the second advent of Christ remains unfulfilled."

In elucidating the subject and explaining the fulfillment of scripture-prophecy he has presented an astonishing array of facts regarding the world's history and chronology, the nature and object of prophecy, the plan of providence, the system of times and seasons of nature and the periodicity of vital phenomena. The facts of nature and of revelation are collected and compared, and the author finally claims that all the proofs are of a character that no sober-minded Christian, student can reject.

The amount of information on obscure historical points, astronomy and philosophy crowded into this work is wonderful, and the fact that it has, in six years, reached its sixth edition, is strong evidence of its acceptability to a large class of intelligent readers.

THE THEISTIC CONCEPTION OF THE WORLD: By B. F. Cocker, D. D., LL.D. Octavo, pp. 426. Harper Brothers, New York. For sale by M. H. Dickinson. $2.50.

This work, though not exactly new, is still one of the best constructed arguments in opposition to certain materialistic tendences of modern thought to be found, and is decidedly worthy of the careful study of all who are interested in the question of the personality and providence of God. Professor Cocker is the author of a treatise upon "Christianity and Greek Philosophy," published several years ago which attracted much attention among earnest Christian thinkers, at least. The present essay is devoted to an effort to show that the theistic postulate is not degraded to a mere hypothesis, inadequate to explain the Universe, but that man must still continue to look up to a personal God and to that providence which is pre-eminently revealed in history, "instituting a Kingdom of God upon earth by a supernatural guidance and grace."

The author has constantly in mind the issue made by Strauss in his "The Old Faith and the New," as between God and no God—between the belief in a personal God and the impersonal All, which justifies him as he says, in his attempt to restate and defend the "Theistic conception of the world."

The scope and logical sequence of the work can be judged of from the following titles of the eleven chapters comprised in the book: The Problem Stated; God the Creator; The Creation; Creation—the Genesis or Beginning; Creation: its History; Conservation—the Relation of God to the World; Providence of God in Human History; The Relation of God to Humanity; Special Providence and Prayer; Moral Government—its Grounds, the Correlation between God and Men; Moral Government—its Nature, Condition, Method and End.

The author claims that the signs of the times are propitious, that at present the conflict between reason and faith, science and religion, presents many hopeful indications of an approaching conciliation and that the most candid men on all sides of the question are "hourly catching glimpses of the everlasting harmony which pervades the universe of being and thought."

It is a book that presents the whole subject fairly, thoughtfully and, as we regard it, with powerful force in favor of theism.

WONDERS AND CURIOSITIES OF THE RAILWAY: By Wm. Sloan Kennedy. 12 mo., pp. 254. Second edition. S. C. Griggs & Co., Chicago. For sale by M. H. Dickinson, $1.25.

This handsome and admirably illustrated book contains a condensed history of railroad building and progress all over the world and is a most interesting volume to the general reader, as well as to the railroad man. Commencing with "Beginning in Europe," we are next instructed as to the first American railroads; then as to the "Banding of the Continent," "The Locomotive in Slippers," "A Mosaic of Travel," "A Handful of Curiosities," in railways and locomotives; an account of mountain railways, vertical railways, tramways; the uses and functions of railways in war, the luxuries of travel as shown in the private cars of Vanderbilt and others; descriptions of old and new styles of rails, trains, etc. There are more than twenty illustrations of ancient and modern railroad cars, engines and other improvements.

Taken altogether this book is a success and will have a heavy run if "found out" by the public.

MEDICAL ELECTRICITY: By William White, M. D. 12mo., pp. 203 Fowler & Wells, New York. For sale by M. H. Dickinson, $2.00.

This is a manual for students, intended to show the most scientific and rational application of electricity to all forms of acute and chronic disease by the different combinations of electricity, galvanism, electro-magnetism, magneto-electricity and human magnetism. Dr. White is professor in the New York Medical College for women, and brings to the subject a large experience in the treatment of all classes of diseases and, while he does not discard drugs altogether, he believes that electricity can be made to take their place in many instances. His style is good and his directions for the application of this remedial agent clear and precise, so that no one need make any mistake in its use.

TECHNICAL EDUCATION, AND OTHER ESSAYS: By Prof. T. H. Huxley. Price, post free, 15 cents in postage stamps. J. Fitzgerald, Publisher, 20 Lafayette Place, New York.

This latest number of the "Library of Science" is one of the most valuable and interesting in that popular series. Besides the essay on "Technical Educa-

tion," which by itself is worth more than the price of the whole number, there are four other essays, namely, on Joseph Priestley, the discoverer of oxygen; on the Connection of the Biological Sciences with Medicine; on Sensation and the Sensiferous organs; and on Certain Errors respecting the Structure of the Heart attributed to Aristotle.

OTHER PUBLICATIONS RECEIVED.

Cassell's Family Magazine, American Edition, Vol. I, Nos, 9 and 10, November and December; $1.50 a year, 15 cents monthly; Cassell & Co., New York. *The Virginia*, a Mining, Industrial, and Scientific Journal, Jed. Hotchkiss Editor and Proprietor January, 1885; $2.00 a year 25 cents a month, Staunton, Va. Iowa State Historical Record, published by State Historical Society, at Iowa City, Iowa; January, 1885. National Water Works Co., Kansas City, Mo., revised water rates and rules and regulations for 1885, B. F. Jones, Superintendent, Kansas City, Mo. *Humboldt Library*, No. 66: Technical Education and other essays, by Thomas H. Huxley; price 15 cents; J. Fitzgerald, Publisher, New York. Johns Hopkins University Studies, Herbert B. Adams, Editor. Third Series, II–III: Local Institutions of Virginia, by Edward Ingle, A. B.; February and March, 1885, Baltimore, Md. *The University Review*, successor to *Kansas Review and University Courier*, March, 1885. Signal Service Notes, Nos. VI, VII, VIII, IX: No. VI—A Report on Wind Velocities at Lake Crab and at Chicago, by H. A. Hazen; No. VII—The Study of Meteorology in Higher Schools of Germany, Switzerland, and Austria, by Frank Waldo; No. VIII—Variation of Rainfall West of the Mississippi, by H. A. Hazen; No. IX—The Elements of the Heliograph, by Frederick K. Ward, Washington City Signal Office, 1883. A Correlation Theory of Color Perception, by Charles A. Oliver, A. M., M. D., January, 1885, Philadelphia, Pa. *Pacific Science Monthly*, Stephen Bowers, Ph.D., Editor, Vol. I, No. 1, March, 1885, Bowers & Son, San Buenaventura, Cal. Advance Sheets, Report of Experiments, by Prof. E. M. Shelton, Manhattan, Kansas, March, 1885; Experiments of 1884. *New York Medical Abstract*, February, 1885, Vol. V, No. 2; $1.00 per year; Medical Abstract Co., New York. *Bulletin of Washburn College Laboratory of Natural History*, Edited by Francis W. Cragin, Vol. I, No. 2, price 20 cents, Topeka, Kas., January, 1885. Report of Adjutant-General of Missouri for 1883–4, Jefferson City, Mo. Meteorology of Oakland, Cal. for 1882–3, and 1883–4, by J. B. Trembly, M. D., Oakland, Cal. The Revolution of 1884, J. G. Pangborn, Chicago, Ill., 1885. International Electrical Exhibition, 1884. Report of Examiners on Applications of Electricity to Warfare; Fire and Burglar Alarms and Annunciators; Underground Conduits; Electro Dental Apparatus; Electric Telegraphs, published in Philadelphia, Pa. General Truths in Applied Entomology, by Chas. V. Riley, U. S. Entomologist, Macon, Ga., 1884. Report of the Entomologist Chas. V. Riley, M. A., for year 1884; January 31, 1885, Government Printing Office. Department of Agricul-

ture, Catalogue of Exhibit of Economic Entomology at the World's Industrial and Cotton Centennial Exposition, New Orleans, 1884–5; Government Printing Office, 1884. Bulletins of the California Academy of Sciences, Nos. 2 and 3, January and February, 1885.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

SYSTEM OF AERIAL CONDUITS FOR ELECTRICAL WIRES.—Mr. D. B. Macquarrie, manager of the Missouri and Kansas Telephone Company of this city, is the projector of this improvement, his object being to provide for the construction and maintenance of such a system as will overcome the defects of both underground conduits and the present unsightly pole system—one which shall combine all of the efficiency and simplicity possessed by the one with the desirable compactness of the other.

The invention consists principally in supporting upon posts, or columns designed expressly for the purpose, a continuous chamber in which the wires are confined, substantially as hereafter more fully explained.

In construction a line of supporting posts is provided with suitable flanges at their bases and secured to a foundation of masonry. These posts may be of any suitable material and they may be tamped in the ground as ordinary posts are, but preferably, they are formed of cast-iron with a flange at each end.

The flange at the upper end projects sufficiently at either side of the conduit to form a support for the cover-sections when removed from their normal position. This arrangement obviates the necessity of lowering the cover to the ground when the wires are to be repaired.

In constructing the said conduit, sheet-metal is given the preference as to material. The chamber or conduit is rectangular in cross-section and is composed of a pair of side-sheets to the lower edge of which a flanged bottom-sheet is securely riveted. Bracing-plates, perforated for the passage of the wires, are placed immediately over each supporting-post, they are used mainly to impart rigidity to the sides of the conduit and being provided with flanges they are securely riveted thereto.

The said plates being perforated, they are, of course, utilized as wire-supports, but as they are limited in number, intermediate devices for supporting the wires may be employed. Any of the improved devices now in use for the purpose can be used here.

The wires within the conduit are protected by removable weather-proof covtions having pendant side-flanges and tongued and grooved end-portions.

The length of each cover-section should correspond to the distance between the centers of the supporting-columns.

After the wires have been placed in position, any desired section of the conducting chamber or the entire length thereof may be filled with paraffine, or other insulating compound, but this is not essential to the perfect working of the line.

It is evident from this construction that telegraph and similar wires may be confined in a very limited space—for instance: a ten-inch conduit will accommodate two hundred wires, and their electrical condition and freedom from mutual interruption will perhaps be more nearly perfect than those of any known system.

The described system affords absolute protection to life and property, for, unlike the pole system, it will be impossible for a wire to break and fall from its position in the conduit.

The system will operate equally as well when constructed along the narrowest alley-way as upon the broadest streets—a fact of no small importance in the construction and maintenance of a telegraph system.

IMPROVED FOLDING TABLE.—This invention consists, primarily, in constructing the top of the table in two similar sections that are hinged together; the object being to produce a table that may be folded to the form of a small packing-box.

The construction may be described as follows: A pair of top sections provided with raised border-strips which encircle the edge of each, hinges located upon such strips for connecting the top-sections, a pair of rectangular supporting-frames hinged to fold inward longitudinally upon the under surface of the top, (their cross-bars resting in notches formed in the adjacent border-strips connecting the top sections) and being severed upon a central line and provided thereat with hinges to allow of a transverse fold in closing the top sections together, bifurcations in the lower extremities of the frames, and braces hinged to the under surface of the top for engaging the bifurcations when the table is in use.

The inventor is Mr. J. C. Mehaffey, of Kansas City.

THE ST. LOUIS ACADEMY OF SCIENCE.

In the meeting of the Academy of Science last week Prof. Pritchett gave a description of his work in assisting in the compilation of the topographical map of Missouri. His connection with the work was only as an astronomer, and the Washington University Observatory was held throughout as the basis for all the work. The uncompleted state of the work prompted a suggestion that an attempt be made to obtain an appropriation from the State for its completion. The value of such a showing as might be made of the mineral and agricultural resources of the State, it was thought, ought to induce the making of the appropriation.

Prof. Potter presented some analyses of water made to determine to what extent sewage introduced into the rivers is oxidized and gotten rid of by oxida-

tion. He said opinions of scientists as expressed on this subject did not agree, and quoted some differences. His view was that sewage was oxidized, and to gain evidence on the point he collected specimens of the water to be found in the Mississippi at Bissell's Point, foot of Lesperance Street, off the docks at Carondelet, at the Quarantine station and at Crystal City. The analyses showed that the purest water was found at Quarantine, which is two miles below the foot of Lesperance Street, where the worst water was obtained, and where the main sewers empty their contents into the stream. The water at Crystal City was next to the Quarantine in purity, while the water at Bissell's Point, from whence the city's supply is drawn, was third in purity, and Carondelet fourth. He found in this ample proof that sewage was oxidized and the water purified by running freely in a stream, as also an argument in favor of the establishment of the base of water supply for the city at the Chain of Rocks, above the present point, which is below a drainage district of the city.

The next publication will be a memorial to the late Dr. Englemann. Prof. Asa Gray will be here in April or May, and will be entertained by the Academy. Dr. George Richter was admitted to membership. At the next meeting Prof. Nipher will discourse on some electrical experiments.

A STUDY OF AMERICAN WHEATS.

A chemical investigation of the wheats of the country has been going on for two years in the laboratory of the Department of Agriculture. Such results have been obtained that Mr. Clifford Richardson, the chemist, feels justified in giving publicity to them. From very elaborate tables showing the analysis of a great variety of wheats from all parts of the country these deductions are made. The main failing of American wheats is their deficiency in albuminoids. The highest percentage of albuminoids found by Prof. Richardson was 17.15 in a Minnesota wheat. Russian wheats have been shown to contain 29.56 per cent. The albuminoids are regarded as the most valuable part of the grain. Prof. Richardson says it is difficult to explain for what reason American wheats contain so much less water than is given in the foreign averages, but he has never seen a sample which contained as much as the average given by the chemist Wolf for German wheat. He concludes that the hotter and drier summers of America may afford the explanation. A comparison of the samples analyzed shows that the wheat of the eastern States is the poorest raised, falling below the average in albuminoids, in ash and in size. The improvement is gradual and regular until the Pacific slope is reached, where there is a decided falling off in quality. The best wheat grows between the Mississippi and the mountains. It has a higher average in oil, albuminoids and ash. The Oregon and California wheats, although showing large and handsome grains, contain a comparatively low amount of albuminoids.

After crossing the Mississippi the averages show that in Missouri and Kansas

wheats are deficient in nitrogen, while Texas produces a grain rich in nitrogen, but injured by too small weight per 100. Minnesota has a much larger grain, not quite so well supplied with nitrogen. It is Colorado which leads in the production of a large grain containing a large amount of albuminoids. That State, Prof. Richardson says, shows what the possibilities are of raising a perfect wheat.

EXPLORING ALASKA.

The country seems to have settled down into a conviction of the unwisdom of wasting money, anxiety, health and life upon arctic research. Even Melville's specious proposition to journey to the pole by the comparatively safe way of Franz Joseph Land has met no encouragement either from public prints or private capitalists, and the young yachting swells of New York, who in the roseate warmth of after dinner enthusiasm last autumn were promising their fathers' millions to send the daring engineer north again, are now discreetly silent. It will be some years, probably, before the Government will send men into the icy regions merely to extend geographical knowledge, and it may be that the dreadful results of the Greely expedition, though its purpose was a better one, will put a stop to the national encouragement of this sort of adventure forever. The Government is, however, encouraging explorations in our own territory, in regions not difficult of access, of great geographical and commercial interest, and yet comparatively unknown.

Four expeditions have been sent to Alaska within two years, and have succeeded in giving us a knowledge of the magnitude and possibilities of that once despised possession which is inspiring lofty dreams of national and private wealth. Its fisheries have returned the Government an interest of nearly five per cent a year on the $7,200,000 which Secretary Seward paid Russia for Alaska in 1867, as a delicate acknowledgment of our gratitude for that nation's firm friendship during the rebellion, and now it is found that the possession which we then did not especially want contains vast rivers, mountains, forests and mines of undreamed of riches. Private companies are contemplating the exploration of the country; there are rumors that they are already being carried on in secret and for dishonest purposes; while a fifth Government expedition is nearly ready to sail from San Francisco under the command of Lieut. George M. Stoney.

This young officer has already headed two expeditions to Alaska. He was one of the Rodgers party, who after the burning of that steamer were greatly aided in their retreat southward by the Tschoutche Indians of Alaska. The Government sent him back in 1883 with presents for these Indians, and while with them he heard of a great river that emptied itself into Hotham Inlet, south of the Yukon. With two men and a dingey and ten days' provisions he explored it fifty miles, and found it could be navigated by large steamers for that distance. Last year he explored the river—named Putnam River, in honor of the young officer of the Rodgers who was lost on the ice near Siberia—for nearly 400 miles

and the present expedition is to continue the work. The river, he thinks, will rank among the great rivers of the world; numerous streams flow into it, and it is surrounded by dense forests of spruce and pine and birch, and by a general richness of vegetation unlooked for in so high a latitude.

The Putnam is not so great a river, however, as the Yukon, which Lieut. Schwatka explored in 1883 for 1,800 miles. He crossed the country 150 miles from Sitka in May, to the headwaters of the Yukon, where he built a raft, and floated down the stream, through marshes, deep lakes and great cañons, where the water sometimes rushed for five miles between huge basaltic cliffs. The Yukon "is so long," says Lieut. Schwatka, "that if its source were at Salt Lake, its waters might empty into New York Bay, and its mouth is so wide that New York would be on one side and Philadelphia on the other." Another expedition, under Lieut. Abercrombie, attempted last summer to explore the Copper River, which is from 400 to 500 miles long, but did not penetrate it far.

Of the wisdom and utility of these explorations there can be no question. Alaska is not ice-bound the year through; steamers can get to Point Barrow, the northernmost land, at almost any time, and sailing vessels can reach it in ordinary summer weather. We know the country almost for its fisheries alone; its immense and almost inexhaustible tracts of timber are scarcely touched, and its mineral wealth is almost a matter of speculation. The research should be exhaustive and more distinctly scientific than it has been; and it is pre eminently a Government work.—*Globe-Democrat.*

COAL-DUST IN COLLIERY EXPLOSIONS.

Bergrath Althaus, in a recent session of the Natural History Division of the Silesian Society *für vaterlandische Cultur,* made an interesting report concerning the work of the Prussian Commission for the discovery of safeguards against fire-damp, in the course of which he called special attention to the effect of coal-dust in aggravating the disastrous effects of explosions. Of the fatal accidents in Prussian coal-mines, $\frac{1}{11}$ are due to fire-damp; and the average number of deaths per explosion *where coal-dust is present* is 5, against 1.4 where coal dust is absent. This statistical argument is conclusive as to the importance of a study of the part played by coal-dust in such cases. The paper of Mr. Hutchinson, published in the Engineering and Mining Journal, January 10th, 1885, sums up the English investigations of this subject, almost to the present time (we believe one or two important papers have appeared since it was written); but it is less full and satisfactory as to what has been done in Europe; and it leaves in doubt the vital questions involved.

Bergrath Althaus, in the report to which we have referred, says of the English investigations, particularly of Galloway and Abel, that "they did not succeed in completely explaining the influence of coal-dust; and hence opinions on the subject continue to differ." But he remarks, a little farther on, that the

xpensive experiments conducted since the middle of 1884, at the König mine, t Neunkirchen, near Saarbrücken, have completely solved the problem, have set ll doubts at rest. He says: "We can now distinguish dangerous from harmless oal-dust. We know where we must forbid the use of fiery explosions altogether, nd substitute other means."

The report of the experiments at the König mine we shall discuss in a later ssue. Professor Hasslacher, of Berlin, who acted as reporter of the Prussian ommission, has made some general statements concerning them, from which it ppears that all kinds of coal-dust are capable of exploding violently when ignited y such means as the electric spark, and that the extent of the explosion is much reater with coal-dust than with fire-damp. These conclusions contradict those f the earlier French Commission, which thus appears, on insufficient evidence, have underrated the danger from this source. The Prussian experiments go show that dust without the recognizable presence of fire-damp may become, nder some conditions, a destructive agent. A thorough study of the experi- ents themselves will be required, in order to see how far they explain the most npressive fact of all, namely, the fact that so many dusty coal-mines and coal- reakers never have any explosions. No theory which does not somehow ac- ount for this fact can be considered complete.

Concerning the quantity of fire-damp generated in Prussian mines, Mr. lthaus observes that 9,000,000 cubic meters escape annually from the shafts of e very fiery Neu-Iserlohn I. mine; and that the seven most dangerous West- halian mines produce annually 39,000,000 cubic meters. He adds that all the ties of Prussia could be lighted with the gas escaping from Prussian coal mines.

The Pieler alcohol lamp and the Wolf benzine lamp are praised as the most nsitive indicators of the pressure of fire-damp; the former showing so small a roportion in the mine atmosphere as 0.25 per cent, and the latter 2 per cent. ince explosive mixtures contain more than 6 per cent, the warning thus given ould in most cases leave ample time for preventing the danger by increased sup- y of air, the only radical and effective safeguard.—*Engineering and Mining Journal.*

THE PERMANENCY OF WROUGHT-IRON STRUCTURES.

The following by Prof. Rossiter W. Raymond, shows that the views dvanced in another article in the present number upon "The Fatigue of Met- s," are not unanimously accepted by engineers and physicists :—[*Ed. Review.*]

An elaborate report By Professor Thurston on the present condition of the on composing the structures of the New York elevated railroads, conclusively iows that these structures have not been overstrained; that they are made of ood material, and as good now as it was the day it was put in place; that they e well-proportioned and of a strength far beyond the danger limit for any one f the possible causes of deterioration; that they are not subject to risk of ystalization or of any other source of injury to quality and strength known to

engineers. Professor Thurston's thorough discussion will perhaps, for a time at least, silence the prating of newspaper engineers about "vibration," "crystallization," "decay," and what not.

We cannot forbear to quote a few sentences:

"So far as I am aware, and so far as I can ascertain, there is no evidence extant, and nothing to give the slightest foundation to the belief, that good wrought-iron, loaded within the elastic limit, will ever yield either to stationary or to intermittent unreversed loads, or that crystallization can ever take place under such conditions.

"Thus, that distinguished engineer, the late Mr John A. Roebling, reporting upon the condition of the great Niagara suspension bridge several years after its construction, states: 'After a thorough examination, I am unable to report any change.' Experiment exhibited the same deflection as when the bridge was first built, and no evidence of loss of strength or stiffness was detected by his repeated measurements of the bridge under load. The same engineer, removing the old aqueduct over the Alleghany river, at Pittsburg, after forty years of continuous service, found the iron suspension-rods to be quite equal in quality to new iron. It was used again in a new structure. Tie-bars that had been in service underground, imbedded in clay for twenty-five years, were found in equally good condition as to quality of the metal. The old St. Clair Street bridge, near the same locality, after forty years of service, was taken down to make place for the later suspension bridge at Pittsburg, and its iron was unchanged in quality. Iron originally crystalline remained so; the iron found fibrous at its removal was fibrous when first used; no change in either direction had taken place.

"Testing iron wires from the old Fairmount suspension bridge, taken down a few years since to make room for the new and stronger truss-bridge at Philadelphia, over the Schuylkill, and comparing it with good merchant qualities of wire of the same gauge, I found the two lots of wire substantially the same in quality. Thirty years of work had not apparently affected the wire of the bridge in the least."

It is a serious question, and one which time only can completely answer, whether steel structures will prove as uniformly and permanently reliable as wrought-iron has proved to be, or in other words, whether the fibrous texture of wrought-iron can be equaled in this respect by the granular texture of steel or of ingot iron. In this connection, it is interesting to note that the fibrous texture referred to is imparted to wrought-iron by the presence in it of a small proportion of slag from the puddling-furnace; and that this can be secured in the Bessemer converter also, if desired. The so-called *Kleinbessemerei*, carried on at Avesta, in Sweden, for several years past, produces exclusively soft, fibrous iron by the simple device of pouring slag and iron together into the ingot-mould. This requires however, a very small charge (usually not more than half a ton), and a direct pouring from the converter, without the intervention of a ladle, which would chill the slag.

SANITATION IN ST. LOUIS.

Under the auspices of Alplin Council, Legion of Honor, the first of a series of lectures on sanitation was given at the Pickwick before a large audience by Mr. Robert Moore. The lecture was not burdened with either diagram or charts, but Mr. Moore dealt with the question of drainage in a manner that could not fail to be understood by every one present.

At the outset he remarked on the advance of medical and social science during the last hundred years, and said if man could not add to his stature, he had, by taking thought, added to the number of his days. The chief factor in these beneficial changes was the increase and wide dissemination of the knowledge of the laws upon which life depended. Another factor had been the deepening of the idea of the interdependence and kinship of mankind. From pure selfishness, or from no higher motive, men are now forced to become their brothers' keepers. Another cause was the enormous increase of wealth which the inventions of the last hundred years had brought to men. People were now better fed, better clothed and better housed than their grandfathers were, and consequently enjoyed better health than their grandparents.

The essential conditions to health in large towns were pure air, pure water and pure soil, and the securing of these conditions was the all-important task of the sanitary engineer, and the great test of success in all city governments. The great factors in securing these conditions were the water supply and the sewerage system of a city. Whatever system was adopted—the system of separate sewers for the storm water and the waste water from the dwellings, or the combined system—the general principles were the same. It was necessary that the sewers should be self-cleansing, and that there should be a good outfall from which the sewerage should be promptly and completely carried away. In many places the latter condition was the chief difficulty of all.

St. Louis was particnlarly fortunate in these two respects. Its sewage was carried away by one of the greatest rivers of the world, while Chicago was at the present time seriously considering how to keep its sewage out of its drinking water. Dealing next with the drainage of houses, the lecturer said it was most important that the surplus water should be discharged as soon as possible into the sewer, and that no noxious gas should be allowed to find its way back into the house. House drains should be self-cleansing, and to that end it was important that the pipes should be no larger than was actually necessary, and above all, that they should not leak. Inside the house there should be no plumbing fixtures which were not in daily use.

In conclusion, the lecturer emphasized the fact that owing to the improved sanitary condition of St. Louis about 5,800 lives were saved every year. He showed that St. Louis was naturally a healthy city, and urged that what was needed, in view of the threatened cholera epidemic, was the closing of the eight thousand or more wells and the thirty thousand cesspools in the city. Their continuance was a disgrace to St. Louis, and it should be the duty of every citizen to see that they were closed.

EDITORIAL NOTES.

THIS is the last number of the eighth volume of the REVIEW, and we do not hesitate to call attention to the improvement made in the magazine since its commencing in 1877. Few persons expected it to live so long, and it has been a surprise to its editor and publisher that it has done so, considerering the very little time that he has been able to give to working up either subscribers or advertising patronage. Despite this it has attained a standing among the periodicals of the day that is a source of pride and pleasure to him. At the same time it would be an additional gratification if its circulation would be so extended as to make the REVIEW fully self-sustaining. A hundred more subscribers would place it in such a position, while every one beyond that number would help to enable the publisher to increase its attractions by means of illustrations, better paper, etc.

It seems to us that it would be no great burden for each subscriber and friend to obtain one more, and thus make the REVIEW, which is acknowledged by all to be a credit to Kansas City and the West, an undoubted success.

MRS. FLORA ELLICE STEVENS, of Bloomfield, N. M., writes that she has an Aztec skeleton which was excavated from the Aztec ruins, fifteen miles from that place, which can be had by any scientific association or museum for a nominal price. This is a good opportunity to secure a valuable curiosity.

AS ILLUSTRATING the magnitude of the zinc and lead interests of Southeastern Kansas, it may be said that the shipments of zinc ore from Galena, Kas., during 1884 was 32,987 tons, which brought an average of $15 per ton. There were also 10,341,087 pounds of lead produced, worth $20 per ton.

DURING the last month our three medical colleges held their commencement exercises and graduated about forty young doctors. At the Medical Department of the University of Kansas City, Dr. E. R Lewis, of this city, and President E. R. Hendricks, of Fayette, delivered the principal addresses, Rev. N. Scarritt, D. D., conferring the degrees. At the Hospital Medical College Dr. S. D. Bowker delivered the main address, while Dr. Thorne conferred the degrees. At the Kansas City Medical College J. V. C. Karnes delivered an admirable address, Dr. J. H. Thompson gave the advisory lecture to the graduates, and Dr. E W. Schauffler conferred the degrees and prizes.

THE Illinois State Laboratory of Natural History has been transferred from Normal to Champaign.

CORRECTION.—In the article in the March issue by Professor Cragin, of Topeka, upon "The Tertiary in Harper County, Kansas," the error was made, in the sentence refering to the metacarpal splints of the horse, of speaking of them as "*extremely unusual*," whereas it should have read "*extremely unequal*." As the error is both awkward and concerns the only part of the article that he considered important enough to emphasize, we hasten to make this correction as public as possible.

LOCALLY the eclipse of the 16th ult. was a disappointment to the astronomers, who had made considerable preparations for observing it, owing to the cloudy weather which prevailed during the whole day. The reports from nearly all points in the West correspond with this, and even in the East it was not much better. The observers at the Naval Observatory at Washington succeeded in taking a number of satisfactory observations and photographs, but not as many as was expected and hoped.

Two important enterprises for Kansas City were practically put in operation here in March, viz: the completion of the cable railway line across the city, and the triumphant realization of the hopes of the proprietors of the Henry Electric Railway. Both of these enterprises are the result of practical scientific and engineering skill of Kansas City engineers, i. e., of Mr. Robert Gillham and Mr. John C. Henry, respectively, backed up by home capital.

WE have received from Mr. Charles E. Putnam, President of the Davenport (Iowa) Academy of Natural Sciences, a forty-paged pamphlet, written by him in vindication of the Academy, upon the authenticity of the "Elephant Pipes and Inscribed Tablets," in its museum, against the criticisms of H. W. Henshaw, ornithologist of the Bureau of Ethnology at Washington, D. C., published and endorsed by Major J. W. Powell, director, in his Second Annual Report.

We have not time at this last moment before going to press to examine this pamphlet, but will do so before the next issue of the RENIEW.

A VESSEL was moored at Salem, Mass., the other day, with several cases of cholera on board. This is a warning for every maritime city in the country to be watchful and clean up, and the last adjuration to clean up, is just as applicable to Kansas City as to any other city in the country.

We may add to the above that when the cholera does reach our cities, as it probably will, in spite of all the "cleaning up" that can be done in advance, the principal safeguard to the people is to prevent the spread of the peculiar cholera germ itself (different from all other filth) by such sanitary appliances as are utterly destructive of it. Nothing else will effectually prevent its spread when once introduc d into a city.

WE find the following in the *Kansas City Daily Presse*: "Number 10 of the eighth volume of the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY has appeared and is excellent in its carefully selected and original abundant reading matter. This number contains e. g. scientific treatises on the Kansas City cable road, on modern and ancient mechanics and architecture, essays in the domain of geology, astronomy, meteorology; correspondence on the World's Exposition at New Orleans, etc. The editor of the journal—that has many renowned savants for its co-workers—is Mr. Theo. S. Case, postmaster of our city.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, *besides, without additional cost, for one year.*

THE *Atlantic Monthly* for April is a remarkably good number. Its serials by Craddock, Mrs. Oliphant, and Miss Jewett progress admirably, and Dr. Holmes adds the attraction of a poem called The Old Song to his installment of The New Portfolio. The papers on Madame Mohl are also continued, and an essay on Time in Shakespeare's Plays, by Henry A. Clapp, forms a pendant to a former article on Time in Shakespeare's Comedies. A delightful paper entitled George Frederick Handle: 1685-1885, by John S. Dwight; Political Economy and the Civil War, a study by J. Lawrence Laughlin; a story called Fate Dominant, by F. R. Stockton; An Unclassified Philosopher, a sketch; and a paper on the sparrow, by Olive Thorne Miller, are the other attractions of the number. The poetry comprises Fiammetta, by Helen Gray Cone; Cressid, by Nora Perry; The Strange Guest, by Edith M. Thomas; and Easter Lilies, by John B. Tabb. There are also reviews of recent poetry by Browning, Tennyson, and Swineburne, and of Gosse's edition of Gray's Works, together with the usual Contributors' Club and Books

of the Month. Houghton, Mifflin & Co., Boston.

WITH all her other troubles—in Egypt, and Ireland, and Asia—old England has also been passing through a serious agricultural crisis, in which the ancient proverbial expression, "as good as wheat," lost its force, for the price of that commodity touched the lowest point it has reached in the life of this generation. What brought on the crisis, what were its effects, and what remedies have been proposed, are questions that concern the American almost as much as the Englishman, whether he be a producer or consumer of wheat; and they are very ably and clearly discussed in an article by William E. Bear, editor of the *Mark Lane Express*, in the *North American Review* for April. In the same number Charles Dudley Warner presents an interesting Study of Prison Management, while Robert Buchanan, the English poet, discusses Free Thought in America; T. V. Powderly, The Army of the Discontented; and Prof. Hunt, How to Reform English Spelling. The other articles are: The Law's Delay, by Chief-Justice Thomas F. Hargis; and Characteristics of Persian Poetry, by A. R. Spofford. But what will probably attract the most immediate attention in this number is the new department of Comments, consisting of brief criticisms of articles that have appeared in the *Review*. Murat Halstead's political article in the March number is here discussed by three writers—a Democrat, a straight Republican, and an Independent Republican. Richard H. Stoddard comments with a good deal of feeling on Max Müller's Buddhist Charity, and other correspondents take this pleasant opportunity to offer a single thought where an extended article would, perhaps, find neither room nor readers.

POPULAR SCIENCE MONTHLY, conducted by E. L. and W. J. Youmans, and published by D. Appleton & Co., New York, presents the following attractive table contents for April: "The Character and Discipline of Political Economy," by J. Laurence Laughlin, Ph. D.; "The Nervous System and Consciousness, I.," by W. R. Benedict, (illustrated); "Cholera, III., Propagation, by Dr. Max von Pettenkofer; "A Chapter in Fire Insurance," by George Iles; "Cumberland Sound and its Eskimos," by Dr. Franz Boas; "Religious Value of the Unknowable," by Count D'Alviella; "Liquor Legislation," by Gorham D. Williams; "Aristotle as a Zoologist," by Frederick A. Fernald "Apiculture," by Allen Pringle; "Structure and Division of the Organic Cell," by Chas. Morris; "The Chemistry of Cookery," by W. Mattieu Williams; "Internal Arrangement of Town-Houses," by R. W. Edis, F. S. A.; Sketch of Prof. John Trowbridge, (with portrait); Correspondence; Editor's Table; Literary Notices; Popular Miscellany; Notes.

AN informing and timely article on the "Framers of the Constitution," with twenty or more portraits, is the opening gem of the beautiful *Magazine of American History* for April. It is the first instance in the historic literature of America, of the successful grouping of the whole fifty-five of these remarkable men, in one vivid pen-picture. The editor has performed a service that will be gratefully appreciated by hosts of students and writers, and by readers of all grades and ages the country through. The exact data given will prove a great help to teachers; and it should be made as familiar to every American child as the multiplication table. The other articles of the number are of exceptional merit, including as usual a wide range of topics. Price, $5.00 a year in advance. Published at 30 Lafayette Place, New York City.

MIND IN NATURE is the title of a new popular journal of psyhical, medical and scientific information, published at Chicago by the Cosmic Publishing Company, under the management of J. E. Woodhead, at 171 West Washington street. Monthly; $1.00 per annum.

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TABLE OF CONTENTS.

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